GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

FUEL COMPARISONS · 90
TIME-SAVER PIPING CHARTS · 96
PRIMING PUMPS · 120

# Power

November
1951 • 50¢

A McGRAW-HILL PUBLICATION

Alarm systems for better diesel operation — 86

# For outdoor plants...

## Metermax control features all-weather electric drive units

Forced draft fan vanes are controlled by outdoor-mounted Metermax drive unit shown above.

In winter snow or summer heat, weather never bothers the electric drive units which do the muscle work for Metermax Combustion Control. Ideal for modern outdoor station design, these units are specifically designed to operate without added protection from the elements. If a forced draft fan is mounted outdoors, for example, its damper control drive mechanism goes outdoors too—without any steam jacketing or weather shelter. Because driving power is electrical, there's no danger of stoppages due to freezing or clogging.

Here are other drive unit features of interest to power engineers:

**Self-Locking:** double worm and gear drive can't be backdriven; no locking devices needed.

**Self-Releasing:** no unlocking or resetting by operator.

**Simple Remote Control:** instantaneous transfer from automatic to remote manual control; no reset position because system is electric.

**Emergency Operation:** geared-down handwheels on each unit make it easy to move heavy dampers, etc.

**True Position Indication:** electric indicators are unaffected by friction or sticking of dampers.

**Dependable Power Source:** drive units operate from plant auxiliary power, independent of compressed air supply.

For a copy of our new folder giving full details on Metermax drive units, write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

LEEDS NORTHRUP

Jrl Ad NU9-01-463(5)

# Emptying a few gondola cars a day... or a few thousand a week?

## LINK-BELT equipment does either job... better

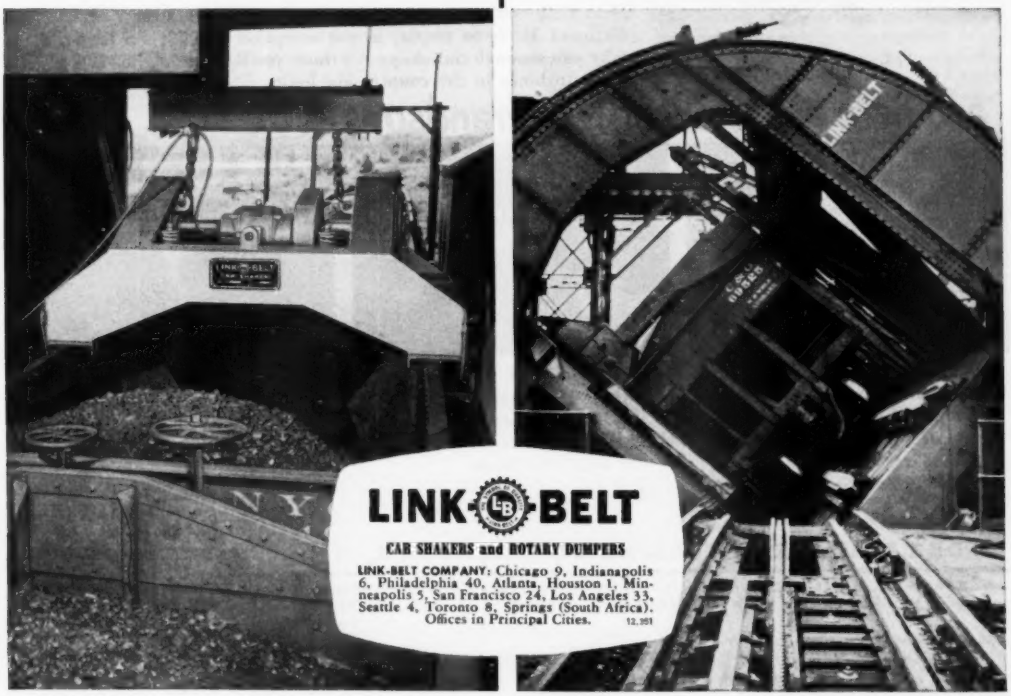
**Get an unbiased recommendation for the right type of railroad car unloader for your needs**

Be sure you get the right railroad car unloader for your particular requirements. Only Link-Belt builds both types — the Rotary Dumper for large users ... the low-frequency Car Shaker for smaller operations.

You'll save time and manpower with either. For both are precision-engineered by Link-Belt to do a specific job faster ... more gently ... at lower cost to you.

**It's easier on cars** ... thanks to exclusive low-frequency vibration. And the Link-Belt Car Shaker also has a much lower noise level. Positive action gets most hopper bottom cars "broom-clean" in a few minutes. Especially good for damp, sticky materials. Write for Book 2345.

**Unloads gondolas in 90 seconds** or less (including return to upright position)! Simple, automatic, fool-proof — Link-Belt Rotary Car Dumper can be operated by unskilled labor. Takes all types of open top cars — any length, width or height ... up to 90-ton capacity. Book 2048-A has complete data.

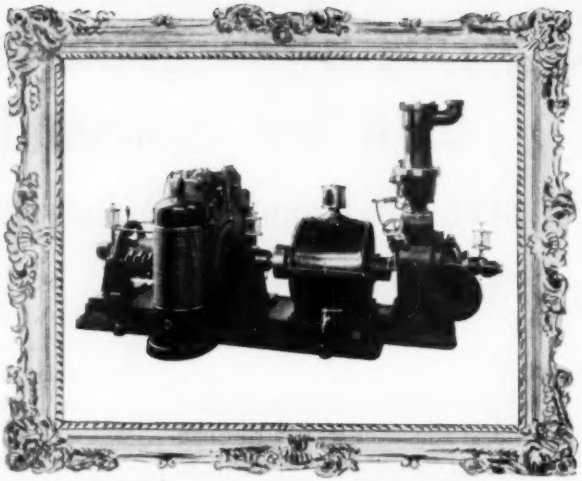



LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities. 12,351

# De Laval Turbines at work!



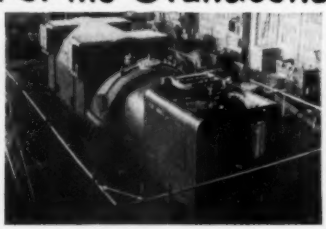
## Meet the Grandaddy of all Turbines

The first turbine-driven generating set to produce current on a commercial scale in the United States was this De Laval unit installed at the Chicago World's Fair in 1893. Grandad was a fast man in his day too . . . he delivered 10 hp at 24,000 rpm. Just four years later, four De Laval 100 hp turbine generators operating at 2840 psi, 750° F and two 50 hp turbines operating at 1420 psi supplied all the power for the Stockholm Exhibition. That is high pressure, high temperature operation even by today's standards!

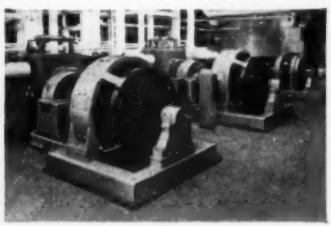
Next time you're in our neighborhood stop in and see Grandad. He is on display in our reception room. Then let us take you through our shops . . . there you'll see how the finest turbines in the country are built.

## and here are a few of his Grandsons—

7500 KW De Laval turbine generator installed in the municipal power plant of the city of Lubbock, Texas. The 15 stage turbine is designed for 600 psi, 825° FTT.



This 11,500 KW De Laval turbine generator and another just like it will soon be supplying power for one of our key Naval bases.



Power for a New England textile mill is generated by these three 1000 KW De Laval geared turbine generators.

**DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.**

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

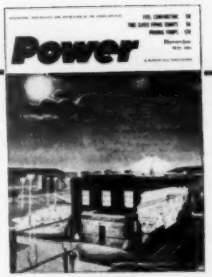
DL 122

50th DE LAVAL Anniversary

# Power

NOVEMBER 1951 VOLUME 95 NO. 11

combined with Operating ENGINEER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**PIPELINE PUMPING STATIONS** are mechanical "hearts" for the far-flung artery network that distributes petroleum and its products. Like their human prototypes, they must run unfailingly day and night. And this demand for utter reliability has made them proving grounds for diesels and other prime movers, for controls and instruments, for new operating, maintenance methods.

In our cover painting, Howard Fogg, official artist of the American Locomotive Co, has caught, we believe, this round-the-clock drama of pipelining. Known to many for his fine paintings of railroad scenes, Fogg demonstrates again his unusual ability to bring to mechanical subjects the realism and accuracy that appeal to engineers and the sensitivity and technique that impress artists.

### *Next month . . .*

■ December's 32-p special section on *Bearings and Lubrication* will cover: fundamentals of overcoming friction, bearing construction and materials, properties of lubricants, methods of applying them, what happens to lubricants in service and how to restore them practical tips on handling and keeping lubricants in the plant.

■ Next *Operators' Notebook* spots the causes of cracked diesel cylinder liners, gives practical ways of avoiding this particular headache.

■ With a good number of gas turbines now in commercial service, attention focuses on the kind of performances they're hanging up. For facts on 17 of them, see our upcoming condensation of P R Sidler's report to ASME.

■ Plenty of tested maintenance hints to try in your plant, and all your favorite practical departments.

### *. . . and future months*

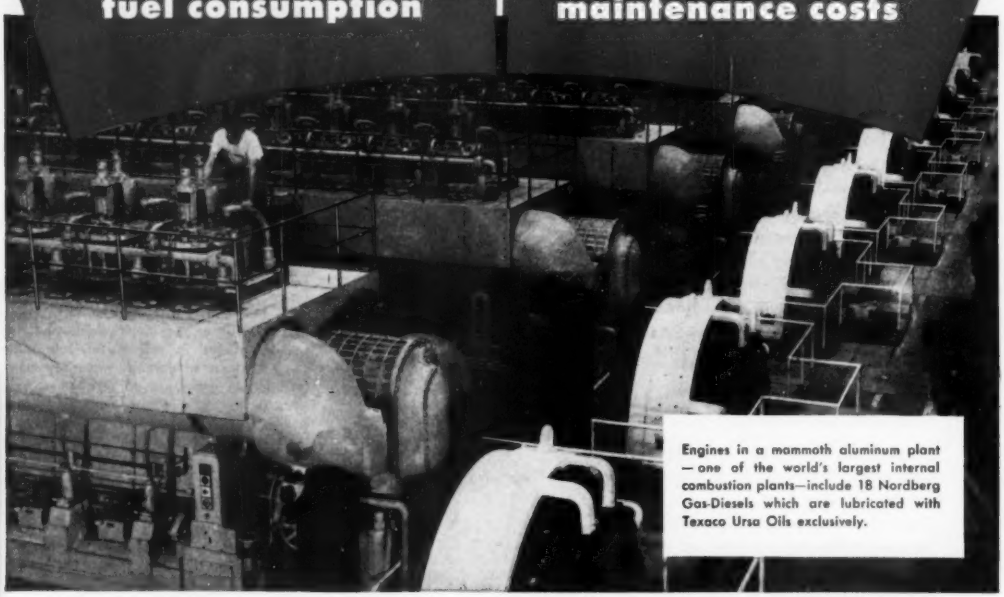
■ Latest for industrial power plants is the triple-automatic-extraction turbine: coming piece tells how it works, how to apply it.

■ With coal stockpiling the order of the day, you'll find good use for our review of safe storage practices.

■ Adapted from production-shop gadget, sensitive leak detector is specially useful for refrigeration lines.

# YOU CAN REDUCE fuel consumption

# YOU CAN REDUCE maintenance costs



Engines in a mammoth aluminum plant — one of the world's largest internal combustion plants—include 18 Nordberg Gas-Diesels which are lubricated with Texaco Ursa Oils exclusively.

## ...by lubricating with TEXACO URSA OIL

Diesel, gas or dual-fuel engines—all run better and cleaner when the lubricant is *Texaco Ursa Oil*. This is the oil with *extra* resistance to oxidation . . . *extra* ability to keep rings free, ports clear, valve action snappy. You can be sure of proper compression and combustion . . . lower fuel consumption.

Maintenance costs are lower, too, because *Texaco Ursa Oil* wards off wear with a tough, friction-fighting film that stands up through the severest kind of service. All moving parts last longer.

There is a complete line of Texaco Diesel lubricating oils – a viscosity to meet every operating condition. They are approved by leading engine builders and preferred by operators everywhere. In fact –

**More stationary Diesel h.p. and more railroad Diesel locomotives in the U. S. are lubricated with Texaco than with any other brand.**

A Texaco Lubrication Engineer will gladly show you how effective lubrication can step up Diesel efficiency and economy in your plant. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

## TEXACO URSA OILS

### FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

**TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.**

# Power

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## ...with Power readers...

YOUNG INDIA SPEAKS . . .

*You will be surprised to receive this letter from a young Indian youth, aged 19 years, who is a keen and enthusiastic reader of your highly technical journal.*

*At present I am in the second year at the Polytechnic Institute opened only recently in 1949. It is the only one of its kind in the whole of Savrashatra province. It has its own laboratorys, pilot plants, workshop, library, etc.*

*Now this institute of ours wishes to publish its own official college magazine early in November and I wishes to utilize an article in the form of an editorial, written and excellently presented by you in your Journal "Operating Engineer" of November 1950 under the heading of "What's an Engineer?" And this article I would like to give in my college magazine. I hope you will surely encourage me by giving permission to reprint and utilize your editorial which exactly tells what's an engineer.*

*Excuse me for the given trouble. I am yours faithfully,*

*Bhavnagar, India* SHIRISH R BHATT

Sure, go right ahead, Shirish, and thanks a lot for this touching evidence of appreciation from the Far East.

I hope and expect that you will grow up to be one of the leading engineers in your

(*Continued on page* 194)

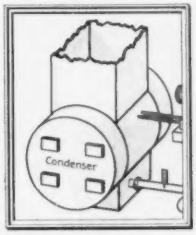
## ...lines and bylines

S W Spielvogel

**PIPING CALCULATIONS** and the name of Spielvogel are synonomous in the minds of many. And it's only natural, for in the more than 25 years that Fred (Siegfried) has been with Consolidated Edison of N. Y., he has specialized in piping design, developed many improved methods, published many papers and the book, *Piping Stress Calculations Simplified.*

In connection with development of ASA's codes on pressure piping, Spielvogel serves as a member of the "task force" on flexibility. POWER readers know his past articles, will welcome his latest contribution, p 96.

We, along with many others, remember Fred best as the soft-spoken graduate of Vienna's technical university who taught us the structural engineering we needed to know to secure a New York professional engineering license. In addition to such extra-curricular activities, Fred finds time for music, and for carpentry and gardening.




"Dimetrics"

**DIMETRICS** is the formal name of a system of drawing we've been experimenting with in our continuous search for better ways of presenting technical information in print. As the sample on p 86 shows, dimetric drawings approach real perspective more closely than isometrics, and are about as easy to produce.

Associate Editor Ben Skrotzki, who has been digging into the subject, likes to go back to fundamentals, tells you that isometrics and dimetrics are both special cases of the trimetric system, in which all three scales are unequal. In the familiar isometric scheme, two 30-deg axes and the vertical all have equal scales. In dimetrics, axes are at 41 and 7 deg, plus the vertical. Two scales are equal, other is one half.

Ben points out that it's easy to make a dimetric grid over which drawings can be sketched using standard 20- and 60-deg ellipse templates. Watch POWER for more examples of this better way of making 3-dimensional drawings. Would you like an article on the method?

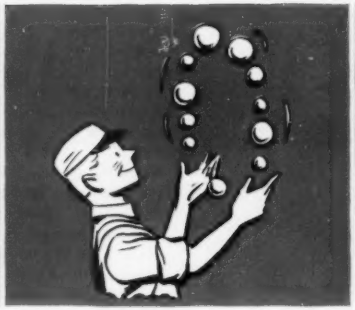
Harvey C Welch

**PRACTICAL** is the word for our good friend Harvey C Welch, a pioneer contributor to *OE*, and now to POWER. From boyhood days on a farm near Princeton, N. J., he's gained experience with men and machines in a succession of operating assignments. His long connection with American Ice Co, from which he retired a few years ago, began in 1913. By 1936 he had moved up to supt of mfg of their Philadelphia department, operating 12 ice plants.

He then went to New York as general supt of mfg and later became general manager of plants. In this post he had charge of production, operation and maintenance of over 50 plants ranging from 60 to 600 tons capacity. It's from this intensely practical background that Welch brings down-to-earth pointers on diesel operation and maintenance and on icemaking, like those on p 122.

# LINE UP for low-cost steam...
## with the B&W Type E Pulverizer

Five B&W Type E Pulverizers, serving a B&W Radiant Boiler of 800,000 lb. per hr. steam capacity.



### RECIRCULATING LOAD— DRIES AS IT GRINDS

Recirculation of fines within the mill gives repeated, quick-drying contact with large masses of heated air and metal . . . produces proper fineness at all loads, even with coal as wet as it can get. Fines are classified in the mill.

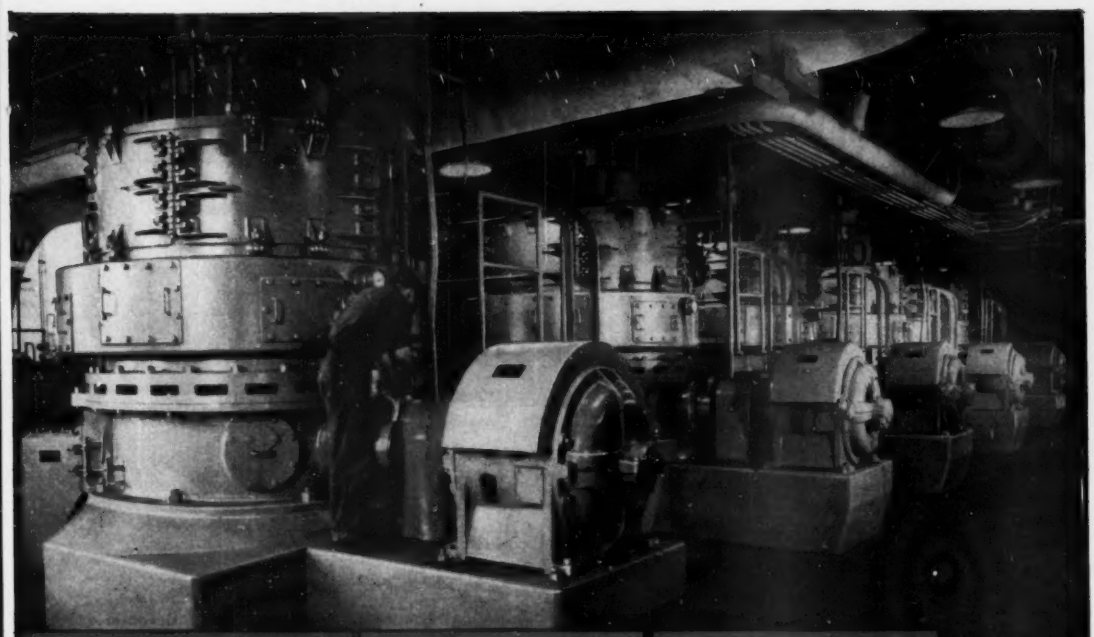
### UNIFORM PERFORMANCE REGARDLESS OF WEAR

Balls and grinding rings wear together . . . assure uniform fineness regardless of attrition of the grinding elements . . . fineness automatically increases at reduced loads.

### BLOWS CLEAN AIR— SAVES WEAR AND TEAR

Unique in pressurized operation, the Type E Pulverizer requires remarkably little maintenance of the primary fan, because it blows only clean air . . . is not subject to the damaging abrasion of entrained particles.

*Bulletin G-57 illustrates and describes the design, construction, operating and maintenance features of the Type E Pulverizer. Write: The Babcock & Wilcox Company, 85 Liberty Street, New York 6, New York.*



### ONE-POINT VARIABLE FUEL-AIR CONTROL

Like the accelerator on your automobile . . . assures proper coal-to-air mixture . . . produces desired rate of steam generation over a wide range with coal conditions suitable for sustained high combustion efficiency.

### LOW POWER CONSUMPTION

Ball-and-ring grinding, anti-friction bearings, pressure lubrication, and automatic rejection of ungrindable materials make possible high output with minimum power demand.

### OUTSTANDING PERFORMANCE RECORD

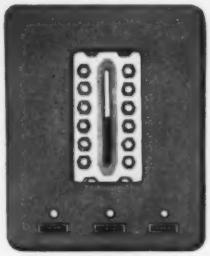
Availability and maintenance economy beyond today's most exacting requirements are proved in over 1300 Type E Pulverizer installations.

*Helping Industry Cut Steam Costs Since 1867*

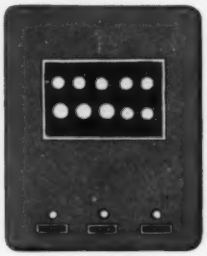
BABCOCK & WILCOX

G-5047

# Rapidly Growing LIST OF UTILITIES Using the DIAMOND "UTILISCOPE" (WIRED TELEVISION)



*Boiler water level observation*



*Burner pilot observation*

*Boiler furnace combustion observation*

*Stack smoke discharge observation*

**Utilities listed below have purchased the Diamond "Utiliscope" for one or more of the uses shown. Images are brought to the boiler control panel where the operator can see them at all times.**

***Ohio Power Co.**
Tidd Station

***Consolidated Edison Co.**
Hellgate Station
Hudson Avenue Station
Waterside Station
East River Station

***Commonwealth Edison Co.**
Fisk Street Station
Ridgeland Station

***Board of Water & Electric Light Comm.**
Ottawa Station,
Lansing, Mich.

***Cincinnati Gas & Electric Co.**
Miami Fort Station
Clermont Station

***Illinois Power Co.**
Wood River Station

***Oklahoma Gas & Electric Co.**
Mustang Station

***Indiana & Michigan Electric Co.**
Twin Branch Station
Tanners Creek Station

***Appalachian Electric Power Co.**
Phillip Sporn Station
Kanawha Station

***Northern Indiana Public Service Co.**
Michigan City Station

**Public Service Co. of Indiana**
Noblesville Station

**Union Electric Power Co.**
Venice Station

**Northern States Power Co.**
Minneapolis Station

***Dayton Power & Light Co.**
Hutchings Station

**Buffalo-Niagara Electric Corp.**
Huntley Station

***Duke Power Co.**
Dan River Station
Lee Station
Riverbend Station

**Union Electric Co. of Missouri**
Meramac Station

**Elecktricitateetssakskabet**
Kydnby Power Station
Isefyordraerkat,
Denmark

**The "Utiliscope" is simple, stable, remarkably durable. It requires no technical skill for operation. Cost is low and is quickly amortized by labor saving and improved operation. Write for Bulletin 1025.**

***Niagara Mohawk Power Corp.**
Dunkirk Station
Oswego Station
Huntley Station

***Societa Edison—Centrale diGenova**
Genova, Italy
Piacenza, Italy

**Central Hudson Gas & Electric Corp.**
Denskammer Station

***Tennessee Valley Authority**
Johnsonville Steam Plant
Widows Creek Plant

**Chicago District Electric Generating Corp.**
State Line Station

**Public Service Co. of Northern Illinois**
Station No. 6

**Kansas Gas & Electric Co.**
Murray Hill Station

***Long Island Lighting Co.**
Port Jefferson Station
Far Rockaway Station
Glenwood Landing Station

**Toledo Edison Co.**
Acme Station

**Philadelphia Electric Co.**
Delaware Station

**Cleveland Electric Illuminating Co.**
Eastlake Plant

**Indianapolis Power & Light Co.**
White River Station

**Virginia Electric Power Co.**
Chesterfield Station

***Southern California Edison Co.**
Etiwanda Station

***Repeat orders have been received from these utilities.**

"UTILISCOPE" REGISTERED U. S. PATENT OFFICE

**DIAMOND POWER SPECIALTY CORP.**
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO • OFFICES IN 39 PRINCIPAL CITIES
Diamond Specialty Limited — Windsor, Ontario
Since 1903, Diamond has Manufactured Quality Equipment For Industry

WRITE FOR BULLETIN 1025

# MECHANICALLY OPERATED VALVE Improves Performance

## OF DIAMOND MODEL IK LONG RETRACTING SOOT BLOWER

The valve now being used on Diamond Model IK Long Retracting Blowers is actuated mechanically by the carriage that projects and retracts the lance tube . . . as shown by the photographs at the right. Opening and closing of the valve is positive . . . dependable . . . accurate.

Note the simplicity of the mechanism. Ample adjustment is provided to permit valve operation to be set at the proper point for each individual blower. This valve has very low pressure drop and is suitable for either steam or air blowing; it has the exclusive Diamond adjustable pressure control unit for selection of blowing pressure to meet individual blower needs. This mechanically operated valve has been in field operation on many IK Blowers in severe central station service for the past two years. Results have been so satisfactory that it is now standard on IK Blowers.

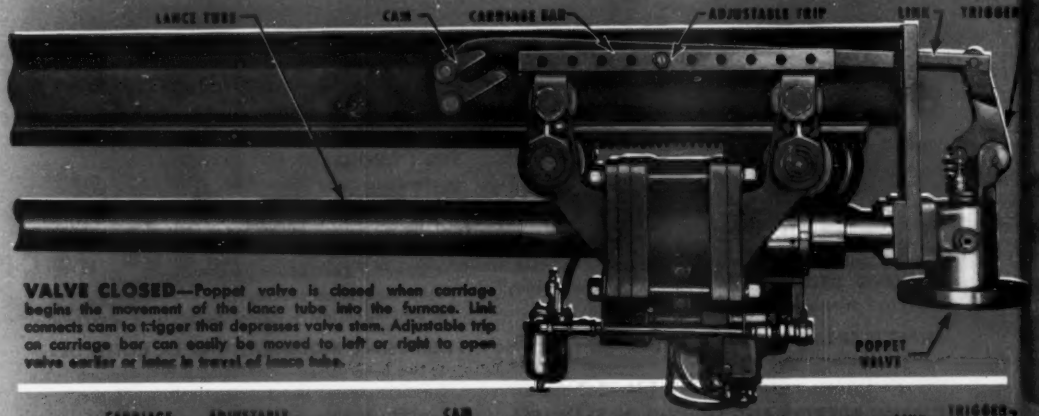
**ADVANTAGES**

- Positive valve action
- Simple and rugged mechanical linkage
- Adjustable valve operating position
- No critical adjustment for tight valve seating
- Completely adaptable to steam and air blowing, interchangeably
- Low pressure drop
- Adjustable pressure control on each individual blower

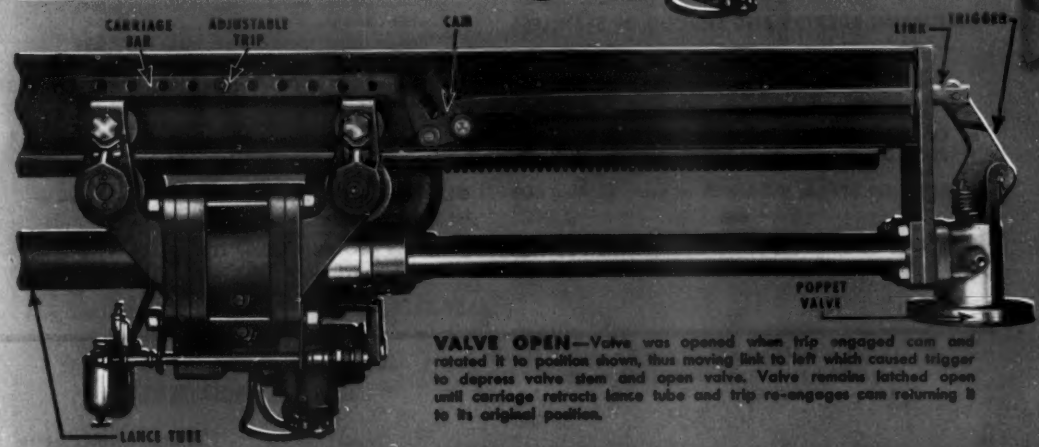
**DIAMOND POWER SPECIALTY CORP.**

LANCASTER, OHIO

*Diamond Specialty Limited • Windsor, Ontario*




**VALVE CLOSED**—Poppet valve is closed when carriage begins the movement of the lance tube into the furnace. Link connects cam to trigger that depresses valve stem. Adjustable trip on carriage bar can easily be moved to left or right to open valve earlier or later in travel of lance tube.




**VALVE OPEN**—Valve was opened when trip engaged cam and rotated it to position shown, thus moving link to left which caused trigger to depress valve stem and open valve. Valve remains latched open until carriage retracts lance tube and trip re-engages cam returning it to its original position.

# Whatever you want in a mechanical drive turbine...

# HERE IT IS!

## Looking for low maintenance?

**AIRWALL LABYRINTH SEALS WITH NO RUBBING CONTACT** protect bearings against dust, fly ash, etc. —

**CENTERLINE SUPPORT** assures constant alignment at all times, irrespective of possible expansion due to temperature changes —

**PACKING GLANDS REMOVABLE** without raising upper half of turbine casing —

**SHAFT IS SPRAY COATED WITH STAINLESS STEEL** under the packing gland, eliminating special maintenance after shutdown —

**TURBINE BUCKETS AND SHROUD OF STAINLESS STEEL** for maximum life and sustained efficiency —

**ROTORS DYNAMICALLY BALANCED** for smooth operation —

**CONSTANT SPEED GOVERNOR READILY ADJUSTED** for permanent speed change —

**BUILT-IN STEAM STRAINER** of heavy stainless steel

and

**STANDARDIZED PARTS** that fit all YR Turbines, greatly reducing parts inventory.

## Looking for custom-built applicability?

**EIGHT DIFFERENT STANDARDIZED TURBINE TYPES** — Five frame sizes — Capacities to 2000 hp. — Speeds, 800-7000 rpm. — Back pressures to 250 psig.

**YOUR CHOICE OF SIX GOVERNORS** besides the standard overspeed governor —

1. Constant speed mechanical shaft governor —
2. Variable speed orifice type —
3. Air-operated remote control —
4. Constant speed oil relay type —
5. Variable speed oil relay type —
6. Built-in constant or differential pressure pump type —

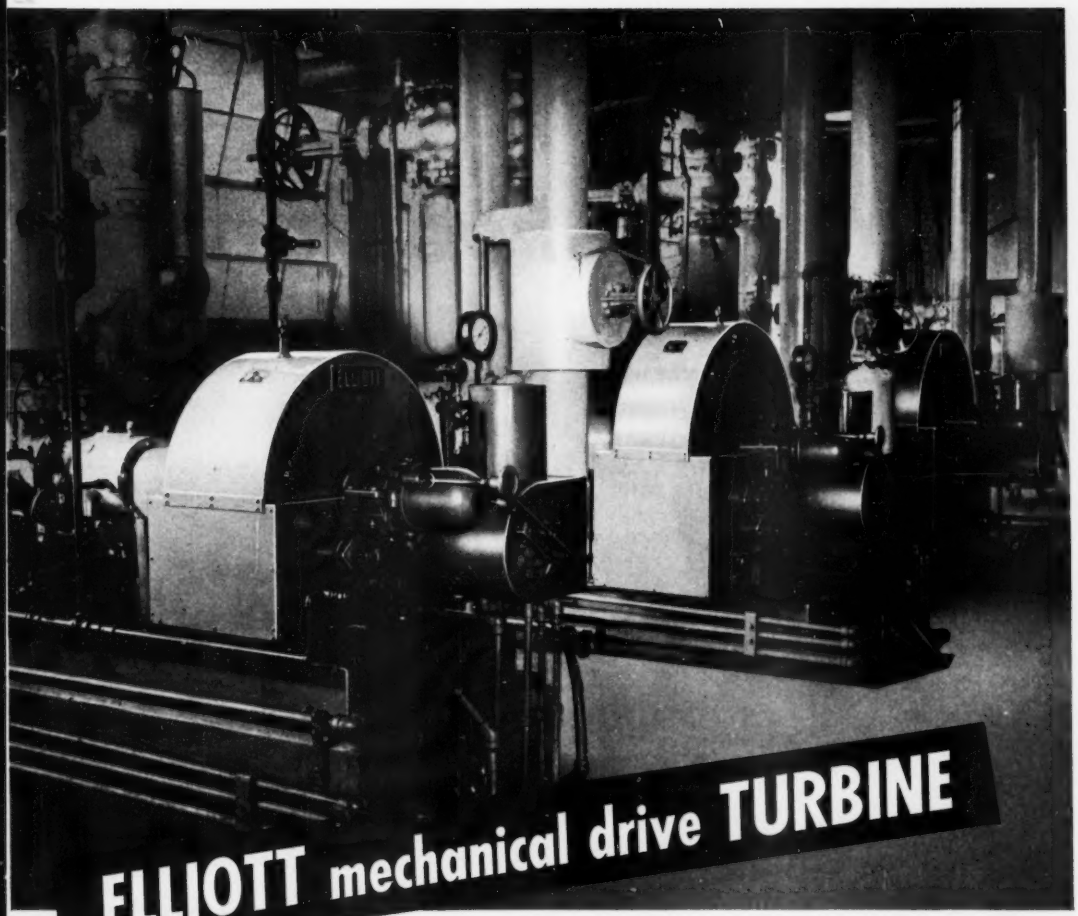
**PERMISSIBLE MODIFICATIONS IN CONTROLS—**

1. Two hand valves — controlling excess nozzling —
2. Hand-operated speed-changer, adjusting speeds while operating —
3. Remote control speed changer, air or electrically operated, adjusting speeds while operating —
4. High exhaust pressure trip actuating emergency trip valve —
5. Remote control electrical trip actuating emergency trip valve —
6. Throttling type emergency trip valve for hand throttling.

**GLAND SEAL PIPING** for condensing operation — or for operation with gas.

**EXHAUST CONNECTION LOCATION** optional — either right or left side.

H-736



# ELLIOTT mechanical drive TURBINE

Everywhere it goes, this turbine makes friends. Its reliability under all conditions is no longer a matter of question. Its low maintenance factor is proven a thousand times over. Its tailor-made fitness for the specific need, the result of its many permissible modifications, is manifest in every industry.

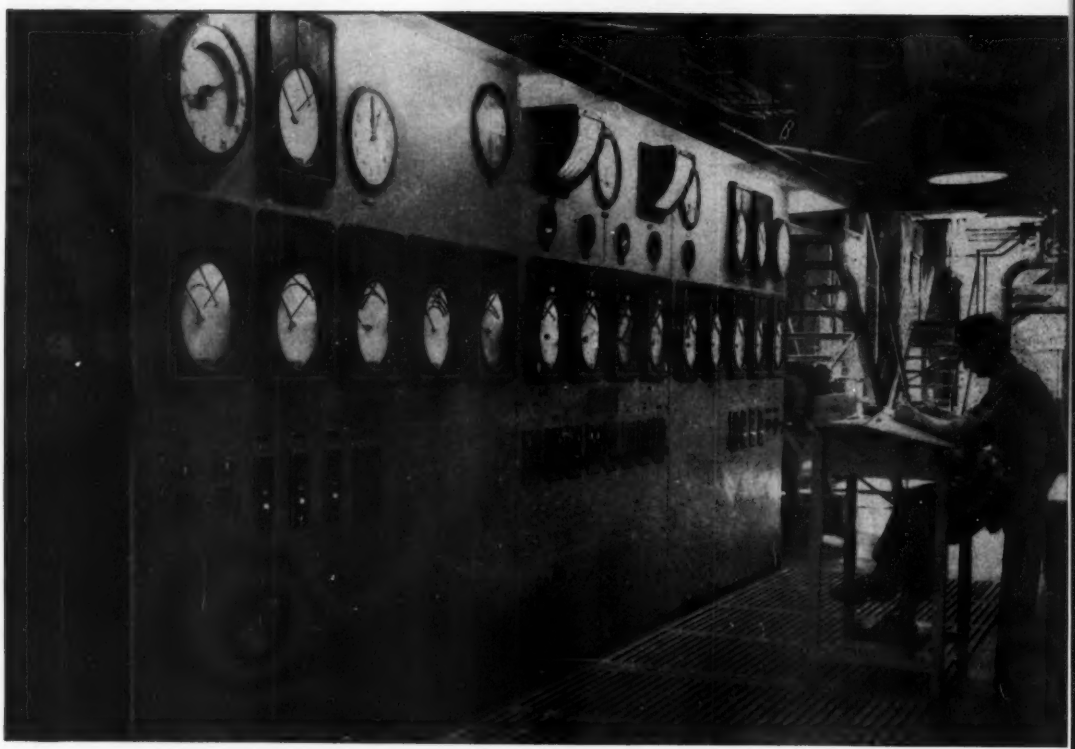
Want all the facts and figures? Write for Bulletin H-16.

**ELLIOTT Company**

***Steam Turbine Dept.***
***JEANNETTE, PA.***

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

# What's YOUR Fuel-dollar



*This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant. It includes Bailey Combustion Control, Bailey Three-Element Feed Water Control and Bailey Steam Pressure Reducing Control for two oil-fired boilers.*

*Controls for Steam Plants*

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

# Efficiency ?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

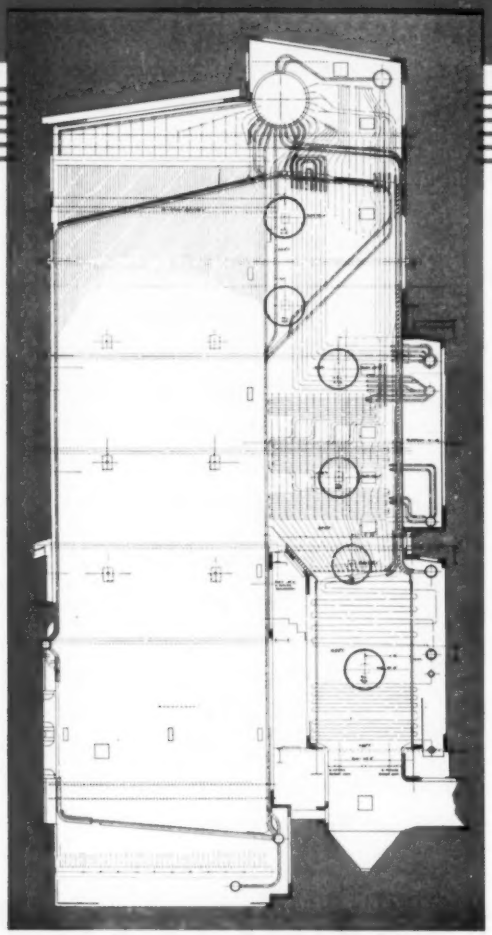
A-109

**BAILEY METER COMPANY**

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

# The MONTANA buys VULCAN for



Rated at 675,000 pounds per hour, this Foster Wheeler boiler will deliver steam from the superheater at 920 psi and 905 degrees FTT. Firing will be with Bunker "C" oil and natural gas.

The Vulcan installation will include twelve long retractable soot blowers, plus two controls for the special air-heater blowers. All will blow with steam and be driven by electric motors. An individual push button control for each blower is provided at the boiler operating panel.

Consulting engineers: Ebasco Services, Incorporated, New York City.

**VULCAN** *Automatic*

# POWER COMPANY this OUTDOOR plant

## *The* FRANK BIRD STEAM-ELECTRIC GENERATING PLANT *at* BILLINGS . . .

Ambient temperatures ranging from −40 to 100 degrees F. will mean many operating problems at the new Frank Bird Steam-Electric Generating Plant. Soot blowing, however, will not be one of these problems. Vulcan automatics will clean the boiler effectively, no matter what the weather.

Driven by electric motors and blowing with steam, the fourteen Vulcans will need no anti-freeze devices—no special provision for lubrication, winter or summer.

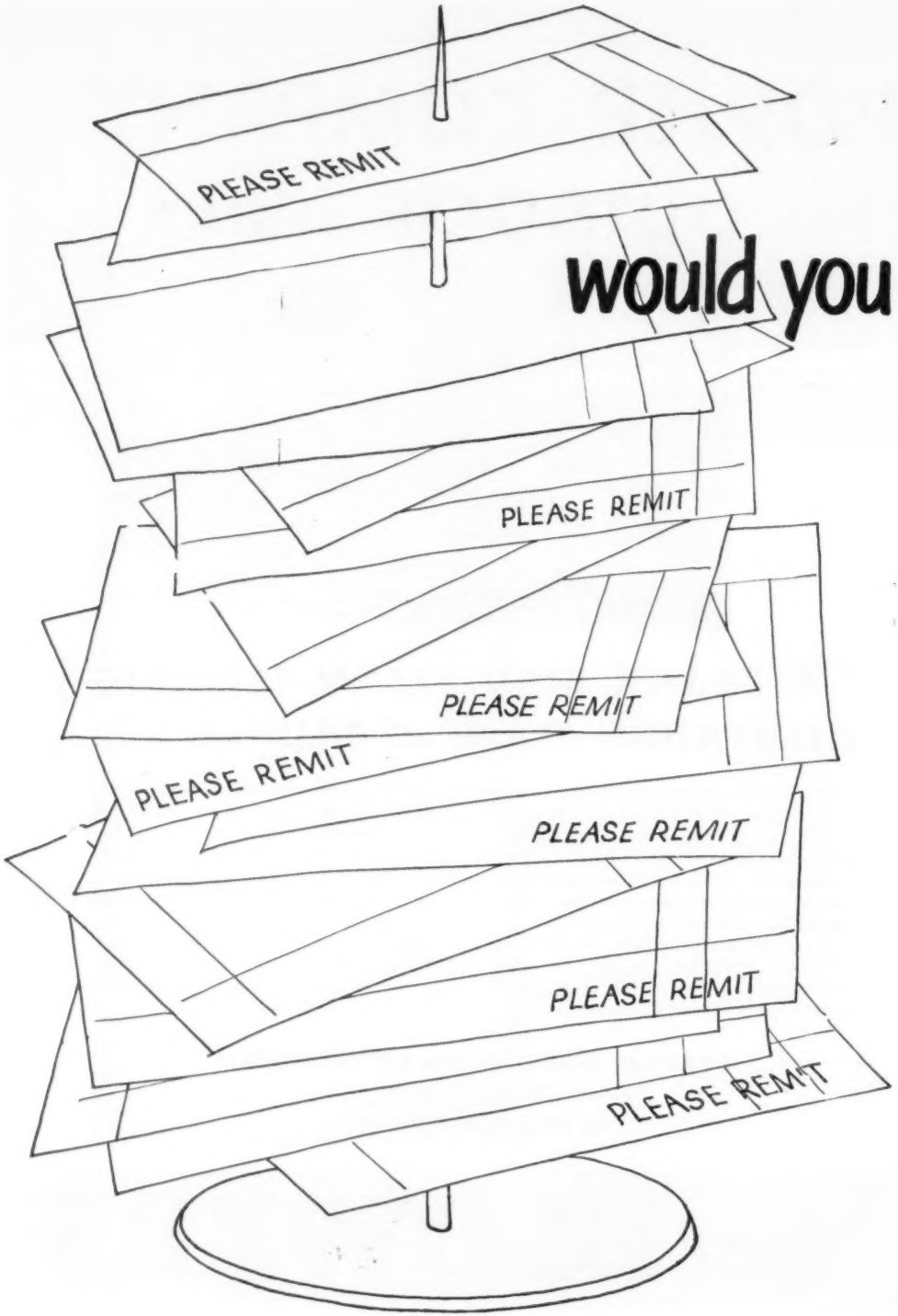
With all blowers operated by push buttons on the boiler panel, operators will not need to step outside the control room to keep the boiler and air-heater passes free from soot. They will have no reason to "forget" to blow soot in bad weather. They will have more time for other duties.

Indoors or outdoors, you can depend on Vulcan for effective boiler cleaning over a long service life, with maintenance costs held to a minimum.

**VULCAN SOOT BLOWER DIVISION**

Continental Foundry & Machine Company

**DU BOIS, PENNSYLVANIA**


PLEASE REMIT
would you
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT
PLEASE REMIT

# pay 16 times

## FOR THE SAME CONTROL SYSTEM?

Of course you wouldn't — but maybe you *do*.

Let's consider a few figures. At a conservative estimate, a good boiler will give you 200,000 hours of service. If it is a 100,000 lb/hr boiler it will burn during that time not less than $8,000,000 worth of fuel—even at today's prices.

If, through failure of your control system to give maximum combustion efficiency, you waste as little as *one per cent* of that fuel, your control system will have cost you $80,000—in addition to what you paid for it originally.

You will still have the same control equipment (you started with)—but you will have paid for it *sixteen times* over!

With a system by Hagan, you pay for your control just *once*. Hagan Automatic Combustion Control Systems are designed for *precise* control. When they are placed in service, they are adjusted by Hagan's experienced combustion engineers, who make sure that you *get* the precision which is built into the control system.

Then, by way of extra dividends, Hagan gives you *long life* and *low maintenance*. The ruggedly built components of the Hagan system last as long as the boiler—and longer. Simplicity of design, using the fewest possible parts, and affording minimum opportunity for wear, makes maintenance especially easy and inexpensive.

Hagan controls are used on every size of boiler from 5,000 pounds per hour at 3 psi to 1,340,000 pounds per hour at 1800 psi. They have been applied to boilers burning oil, coal, gases of various types, sawdust—and always with satisfactory results.

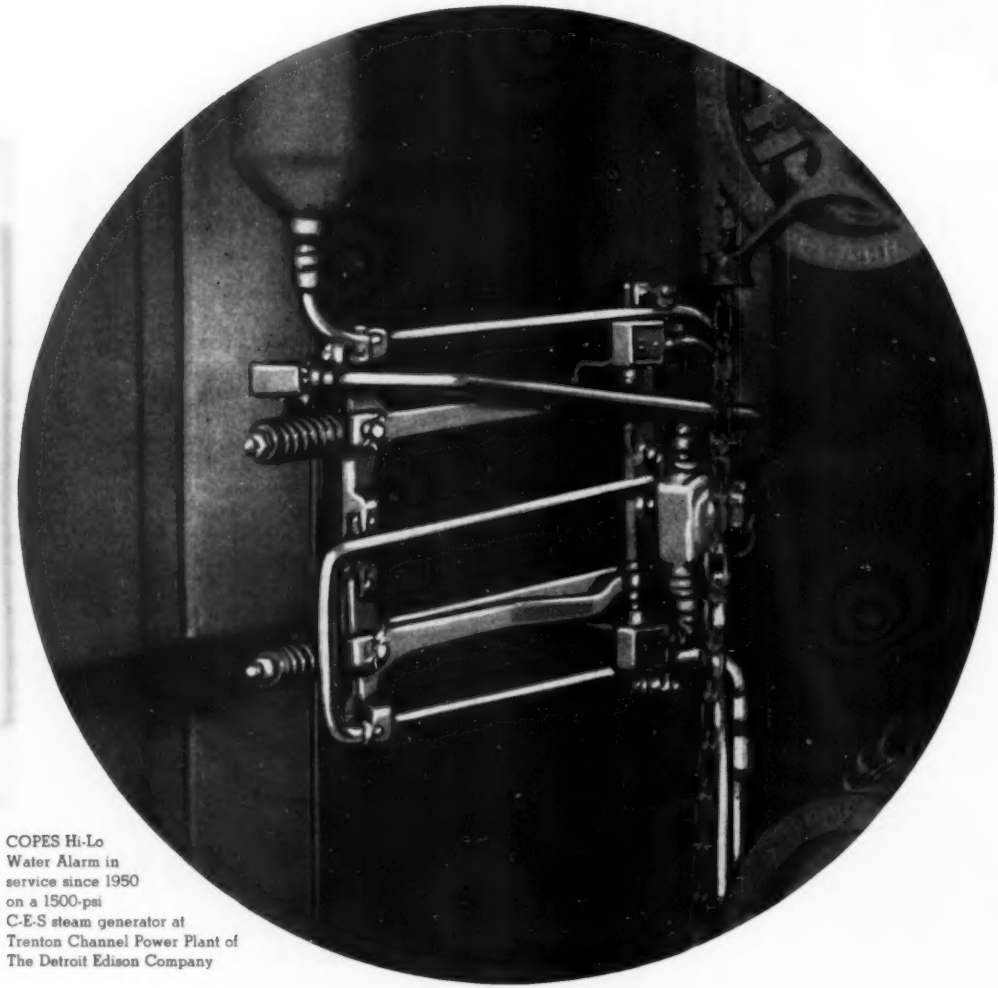
Our engineers will be glad to give you full information on Hagan control systems. Write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

**HAGAN CORPORATION**

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

# COPES Hi-Lo

## as simple and dependable



COPES Hi-Lo
Water Alarm in
service since 1950
on a 1500-psi
C-E-S steam generator at
Trenton Channel Power Plant of
The Detroit Edison Company

**ENGINEERED BY THE MAKERS OF**

# WATER ALARM

## as the COPES expansion tube

HERE'S a new Hi-Lo Water Alarm, based on exactly the same established principle that has made the COPES Feed Water Regulator so successful for the last fifty years.

On both stationary and marine boilers, it gives trouble-free dependability at all working steam pressures.

Simple, fool-proof and maintenance-free. Compact and self-contained. Easily installed without special supports or complicated piping—with or without a water column.

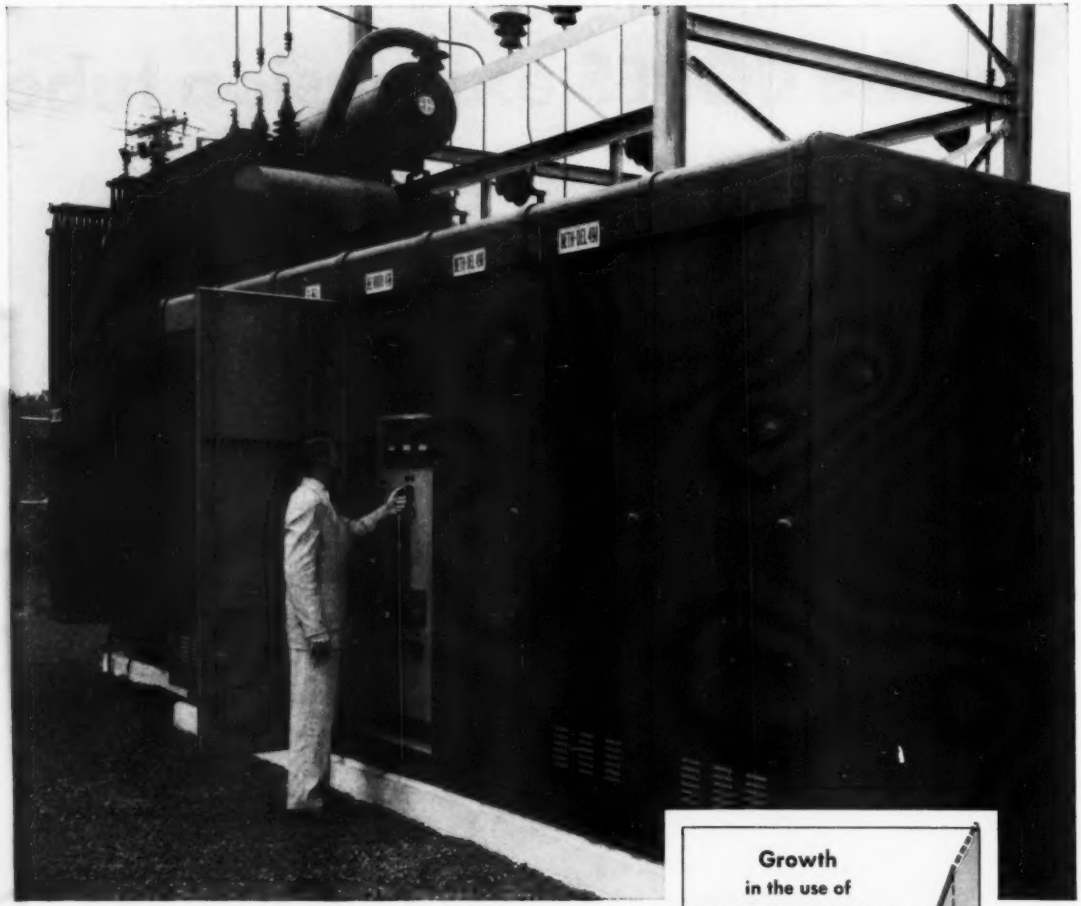
Bulletin 493 tells the full story. Write for it.

**NORTHERN EQUIPMENT DIVISION**
**CONTINENTAL FOUNDRY & MACHINE COMPANY**
**1111 Grove Drive • Erie, Pennsylvania**

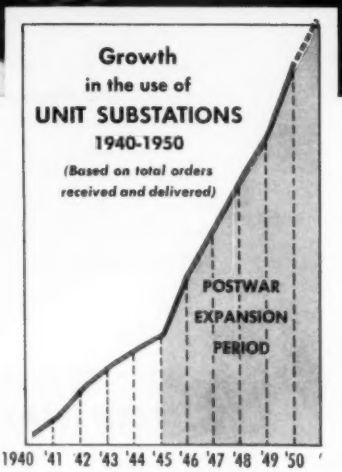
The COPES Hi-Lo Alarm uses no bellows, no diaphragms, no weights, no floats, no differential pressure devices. It has no internal parts to corrode or wear. Standard audible signal is a horn; standard visible signal, lights. Other types of signal can be furnished as desired.

COPES **FEED WATER REGULATORS**

# Niagara Mohawk EXPANDS FAST at



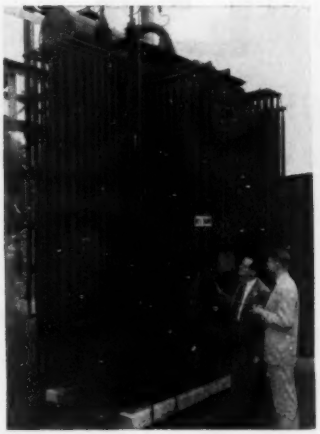
**NIAGARA MOHAWK ADDS 10,000** quickly and easily with third and fourth G-E master unit substations (5000 kva each). The one above transforms 33 kv to 5.04 kv. Open compartment door shows operating panel for magne-blast breaker. More details in photos on opposite page.




**WHAT DOES THIS TREND MEAN?** Savings in time, money and materials are becoming more and more important. It also means that adaptable compact unit substations have proved to be perfectly suited in cases where "special designs" were thought necessary. You get plenty of flexibility when you use G-E packaged substations.

# low cost—with G-E Unit Substations

**CIRCUIT BREAKERS** are safely and easily removed for inspection. This view shows rear of Niagara Mohawk's new G-E metal-clad transformer main breaker in operating position. Breaker cannot be lowered for removal until it is tripped and power circuit interrupted.



**YEARS OF MAINTENANCE-FREE SERVICE** ahead for transformers in Niagara Mohawk's new unit substation. Bus regulation of voltage is provided by load-ratio-control equipment. Experience shows G-E LRC equipment requires very little maintenance.

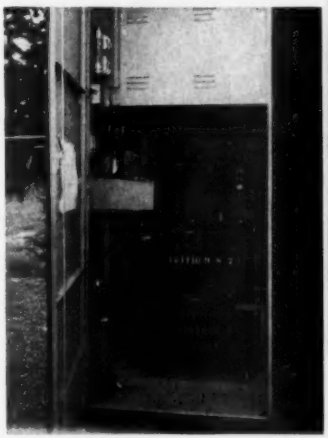
**FORESIGHT PAYS OFF** again and again. Above is section of older G-E master unit substation installed by Niagara Mohawk in 1939. Growing loads posed no problem—new unit (barely visible, upper left) installed alongside, capacity increased by 5000 kva.

## Quick, easy ordering and installation help Niagara Mohawk expand fast to meet increased demand in Albany area

Like many other utilities and industrial plants, Niagara Mohawk Power Corp. has shown it pays to use "packaged" power equipment. In this locality, they've chosen a standard distribution system (in this case: primary network) and a standard load increment, or "building block" of power (5000-kva). As load grows, a duplicate substation of this capacity is tied into the system, always a jump ahead of demand.

A G-E unit substation arrives ready for use—you simply spot in place, connect, and energize. You save not only on equipment and installation costs, but also valuable engineering time to use for over-all planning.

These are just a few reasons for the fast-growing trend to unit substations shown in the chart on the opposite page. Your local G-E representative can show you plenty of others. Call or write him. *General Electric Company, Schenectady 5, N. Y.*



**EXTRA $5000 SAVED BECAUSE OF FLEXIBILITY**

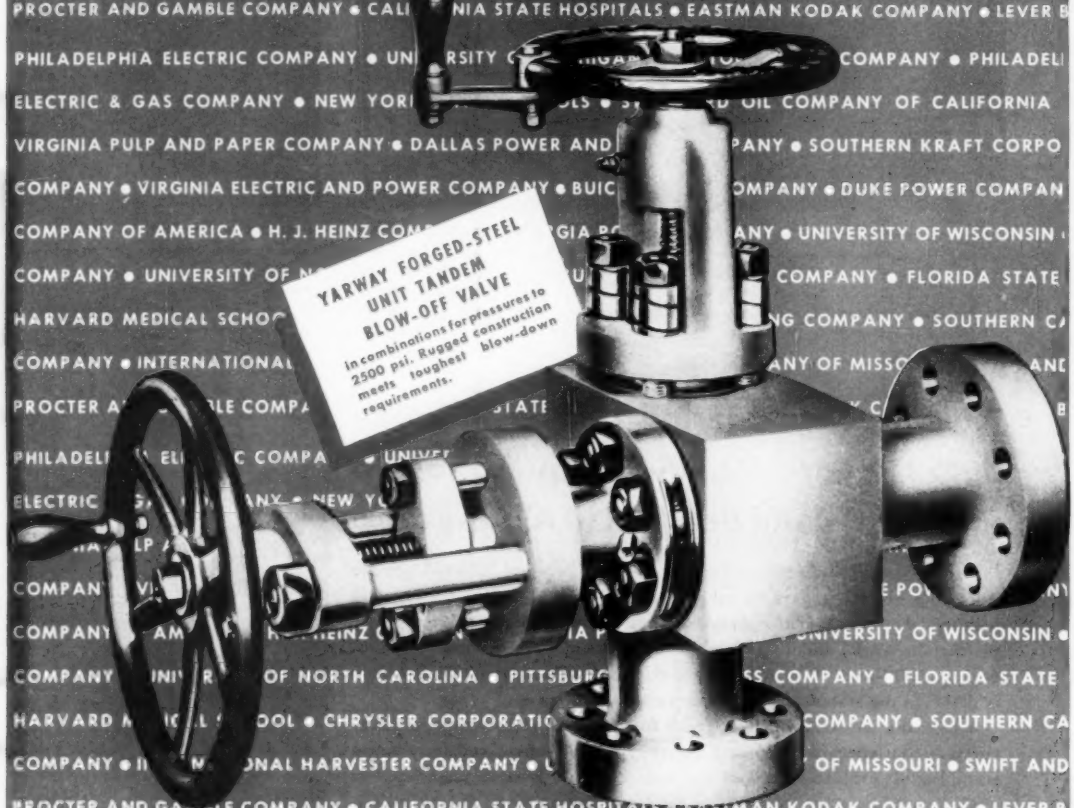
**IDEA TO SAVE MONEY:** Photo above is close-up of G-E metal-clad auxiliary compartment, installed with rest of Unit Substation. Flexibility permitted Niagara Mohawk to install 48-volt battery, charger, telephone. By doing this instead of using special construction, Niagara Mohawk estimates they saved $5000 to $8000.

321-80

GENERAL ELECTRIC

# A BLOW-

## IS KNOWN BY THE


YARWAY FORGED-STEEL
UNIT TANDEM
BLOW-OFF VALVE
In combinations for pressures to 2500 psi. Rugged construction meets toughest blow-down requirements.

## YARWAY

HIA PUBLIC SCHOOLS • PACIFIC GAS & ELECTRIC COMPANY • IOWA STATE COLLEGE • PUBLIC SERVICE
BOSTO ... EST
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... E. I. ... COMPANY ... NY ... UM
... R. J. REYNOLDS TOBACCO COMPANY • CARNEGIE INSTITUTE OF TECHNOLOGY • HUMBLE OIL AND REFINING
HOSP ... SITY ... Y •
LIFO ... ORPO ... OF ... ER ... GHT
... COMPANY • FLORIDA POWER COMPANY • ARMOUR AND COMPANY • UNIVERSITY OF PENNSYLVANIA •

# OFF VALVE BOILERS IT PROTECTS

When buying blow-off valves, weigh the significance of these two facts:

*More than 15,000 boiler plants in the United States and other countries are equipped with Yarway Blow-Off Valves* . . . Some of them for nearly 40 years. *Among high pressure plants, 4 out of every 5 in the United States are Yarway-equipped.*

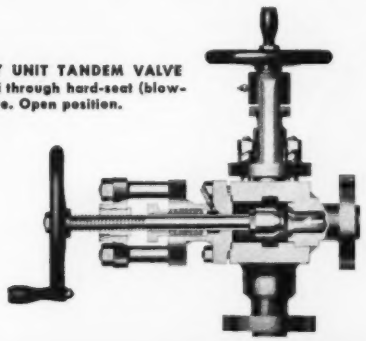
Design, metallurgy, workmanship and service are the reasons. It was Yarway that brought out the famous Seatless Valve, teamed it with a stellited hard-seat valve in a common forged-steel body to make the popular Unit Tandem. Yarway has also made available metallurgical improvements to withstand the chemical reactions of acid wash as well as the mechanical wear of boiler blow-down.

Yarway continues to pioneer and improve blow-off valves and blow-off valve service for both high and low pressure applications.

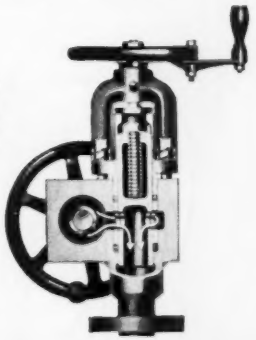
On new boilers, replacements or modernization, make sure you specify Yarway Blow-Off Valves. Any boiler manufacturer will supply them on your specification.

Bulletin B-424 gives you the full story on pressures to 400 psi. Bulletin B-433 for higher pressures. Both are free. Write . . .

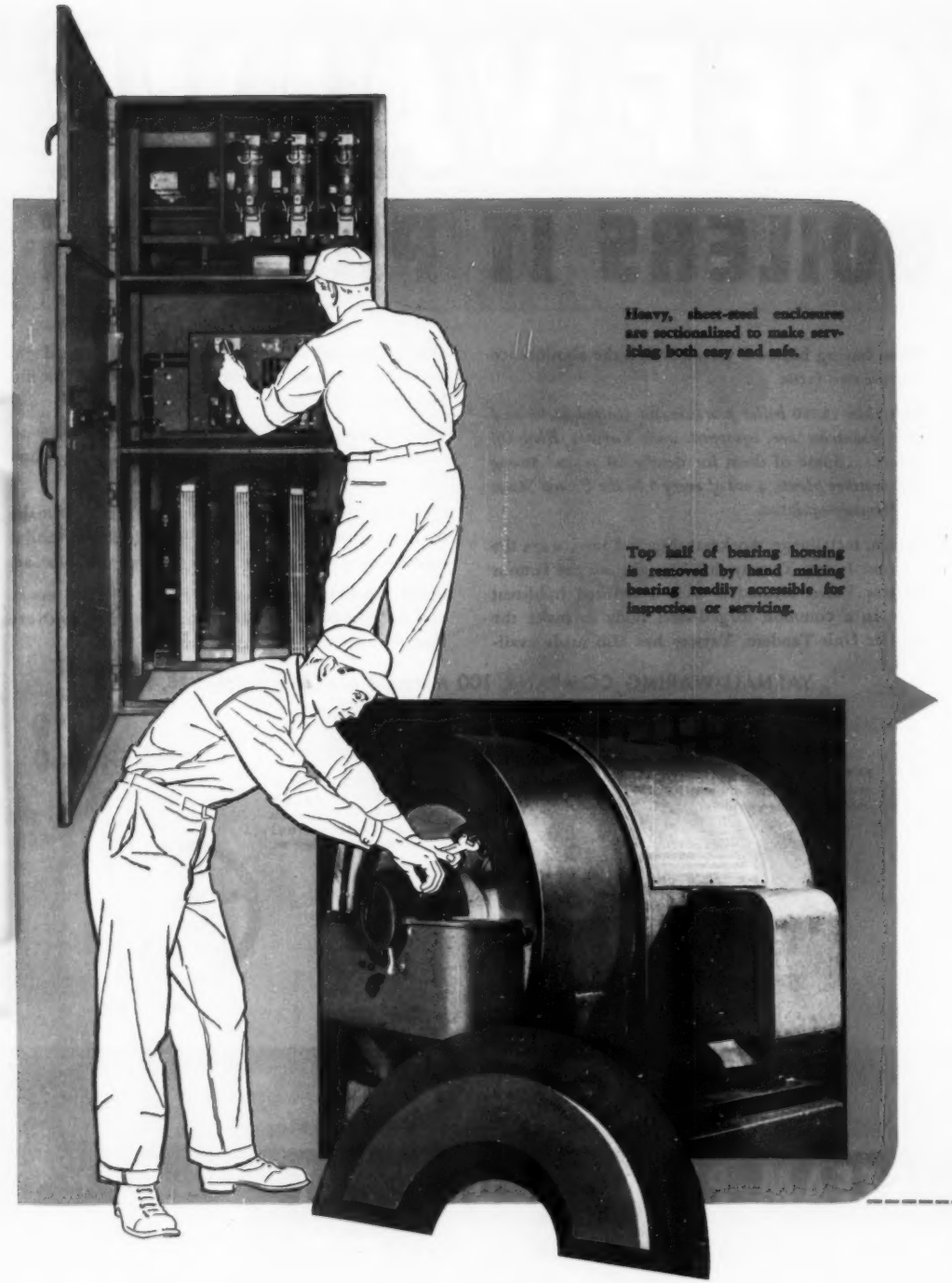
YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.



**YARWAY UNIT TANDEM VALVE** sectioned through hard-seat (blowing) valve. Open position.



**YARWAY UNIT TANDEM VALVE** sectioned through seatless (sealing) valve. Open position.



Heavy, sheet-steel enclosures are sectionalized to make servicing both easy and safe.

Top half of bearing housing is removed by hand making bearing readily accessible for inspection or servicing.

# This matched pair reduces servicing time to minutes

Every servicing operation from checking bearings to replacing contacts takes a minimum of time—without the usual muss and fuss—on this motor and control team. All components are functional in design and easy-to-get-at. No special tools are required.

On Westinghouse Large Induction Motors you simply remove the top half of the bearing housing by hand and the bearing is accessible for inspection and servicing. No top bracket to remove—no crane to lift heavy, cumbersome parts. One man and a few minutes is all that it takes.

One man can remove the motor's light, sturdy sectional covers and air shields by hand also. Here again, no crane is required—complete operation can be performed in a matter of minutes.

An occasional look in the door meets most of the servicing requirements on this Westinghouse High-Voltage Starter with air-break contactor. Simple, dependable design assures long mechanical life of the contactor and its moving parts

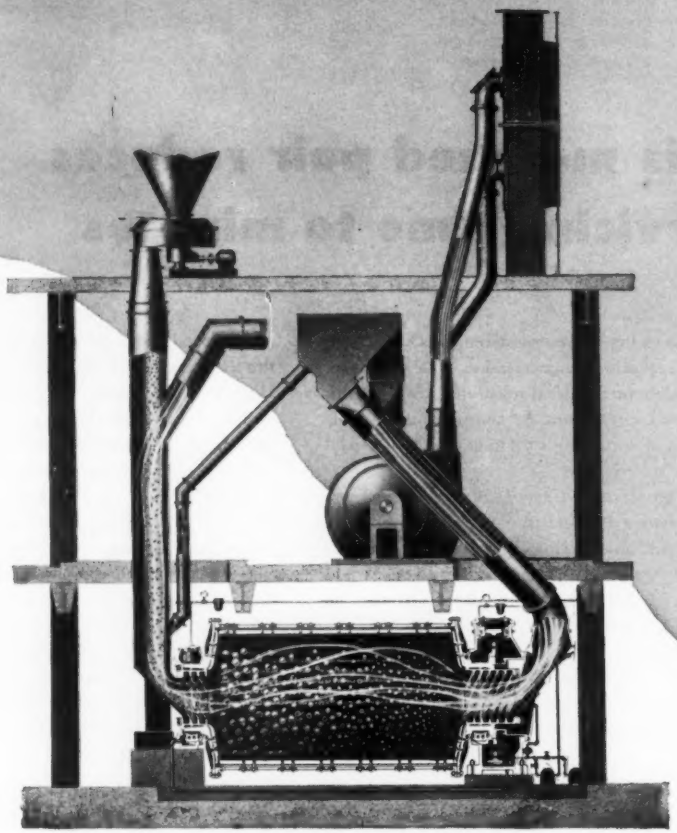
Powerful magnetic blowouts and large arc boxes effectively confine arcs—increase contact life. Built-in fuses are readily accessible . . . easy to install or replace.

Westinghouse Large Induction Motors and High-Voltage Starters are the perfect power partners. Get the benefits of their co-ordinated operation. Call your local Westinghouse representative now for complete details. Or, if you prefer, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10357

YOU CAN BE SURE.. IF IT'S
Westinghouse

LARGE INDUCTION
MOTORS and CONTROLS

# KVS AIR SWEPT



KVS ENGINEERING SERVICE

*KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation on your requirements.*

# TUBE MILLS ...

## ...for the maximum in fuel value and flexibility of fuel selection

Ability to pulverize any coal . . . bituminous . . . anthracite . . . coke breeze . . . in any required quantity . . . means that KVS Air Swept Tube Mills make broad selection of fuel possible. Furthermore, selection can be made on the basis of the fuel which will give the most in value for every dollar expended and hence the lowest cost for each pound of steam generated.

With KVS Air Swept Tube Mills, a superfine product is prepared of "talcum powder" fineness, which is instantly combustible and immediately responsive to combustion controls.

*Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.*

Kennedy Products — Kennedy-Van Saun — Quality Service

**Kennedy-Van Saun**

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

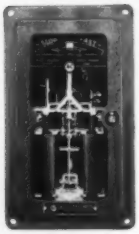
ARMY E NAVY

# ALLIS-CHALMERS POWER PLANT CONTROLS

# 7 Keys

## 1 SYNCHRONIZING MACHINES

Automatic synchronization of generators, synchronous condensers and tie lines, no matter how large, is the job done smoothly, quickly and unerringly by the *Synchro-Operator*. Just turn a control switch and it takes over — indicates relative speed and phase angle . . . anticipates time for circuit breakers to close.



The *Synchro-Operator* is absolutely safe and eliminates the danger of manual synchronizing errors. It automatically brings the incoming machine into step with the line and closes the generator breaker at exact synchronism. With the *Synchro-Operator*, it's possible to synchronize from a remote point.

## 2 ORDER TELEGRAPH SYSTEMS

The Allis-Chalmers Order Telegraph System is accurate and reliable. Sending and receiving orders is accomplished on one dial — saves valuable switchboard space — aids operating personnel. Receipt of each message is assured by an alarm system which operates until the order is returned correctly.

The many uses of Allis-Chalmers dc Positioning Devices include control and indication of remote valves in hydro plants, transmission of orders between switchboard and turbine room, gate position indication and control, water level indication, and hydraulic turbine governor control. Select either a five or ten-inch semiflush dial.

## 5 *ROCKING CONTACT* VOLTAGE REGULATORS

*Rocking Contact* Voltage Regulators have established long records of dependability. "Not one dollar spent for maintenance in fifteen years of continuous service," is typical experience.

Designed for panel mounting, this regulator makes a neat installation on any switchboard. Regulation is achieved by rocking a carbon-rimmed sector over a silver-plated stationary commutator to control the amount of resistance in the exciter shunt field.

When selecting generator voltage regulators, remember that Allis-Chalmers builds both mechanical and rotating types . . . ; makes recommendations based on your requirements.

## 6 STARTING AUXILIARY MOTORS

There is an Allis-Chalmers starter for every motor need . . . full or reduced voltage; for synchronous, wound-rotor or squirrel-cage motors.

Choose Type H Starters for 2300-5000 volt motors. They are engineered to your application — offer complete protection to personnel and equipment through compartmented cubicles, current limiting fuses, overload, undervoltage, interlocking and other devices.

For 110-550 volt motors, sizes 0 to 7 starters cover the range from fractional to 600 hp. Select from a variety of enclosures and operating arrangements to fit your needs.

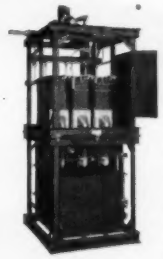
*Synchro-Operator, Regulex and Rocking Contact are Allis-Chalmers trademarks.*

# ALLIS-CHALMERS

# to Dependable Power

## 3 BOILER DRAFT FAN SPEED CONTROL

Draft fans operate at exactly the speed your boilers require for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound-rotor drive motors. The right draft for any combustion condition is provided automatically by the wide range stepless speed control.

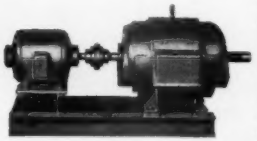


They have few moving parts, no arcing contacts, no mechanical connections to either fan or motor. Not only is the Allis-Chalmers Liquid Rheostat compact in size, but it can be placed in any convenient location — doesn't have to be adjacent to the motor it controls.

## 4 *REGULEX* VOLTAGE REGULATORS

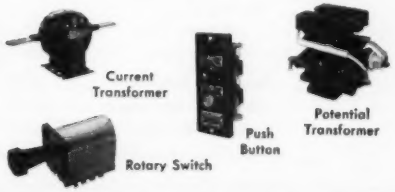
The *Regulex* Voltage Regulator is the most modern method of controlling voltage on large generators. *Regulex* Control eliminates the pilot exciter . . . has no vibrating or moving contacts.

High amplification and fast response of the *Regulex* Generator Voltage Regulator on system disturbances causes the generator field current to reach the required value for stability at the new load rapidly—thereby decreasing the possibility of the generator pulling out of synchronism . . . improving system stability and giving better regulation under all system conditions.



## 7 CONTROL BOARD AND SWITCHGEAR DEVICES

Allis-Chalmers switchgear devices include rotary control switches, pushbutton stations, current and potential transformers, disconnecting switches, indicating lamps, terminal boards, thermal relays, oil and air contactors, oil and air circuit breakers. All are designed and built to the high standards of reliability associated with the name Allis-Chalmers in power plant equipment.




## SEND FOR MORE INFORMATION

These seven key power plant control devices are described more fully in bulletins and leaflets. Check off those you'd like to have on the coupon below and give it to your A-C representative, or send it to Allis-Chalmers, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS Milwaukee 1, Wisconsin**

Send me the leaflets and bulletins checked below:

- ☐ *Synchro-Operator* ..... 14S6386B
- ☐ dc Positioner ..... 14B6641
- ☐ Liquid Rheostat ..... 14S7544
- ☐ *Regulex* Voltage Regulator
  *Rocking Contact Regulator*
  - ☐ for small machines ..... 14B6035
  - ☐ for larger units ..... 14B6015
  - ☐ for dc generators ..... 14B6137
- Starters
  - ☐ Type H ..... 14B6410
  - ☐ Sizes 0 to 7 ..... 14B7132
- ☐ Switchgear and Control Devices ..... 25B7095
- ☐ Type 256 Air Contactor ..... 14B7303

Name ..... Title .....

Company .....

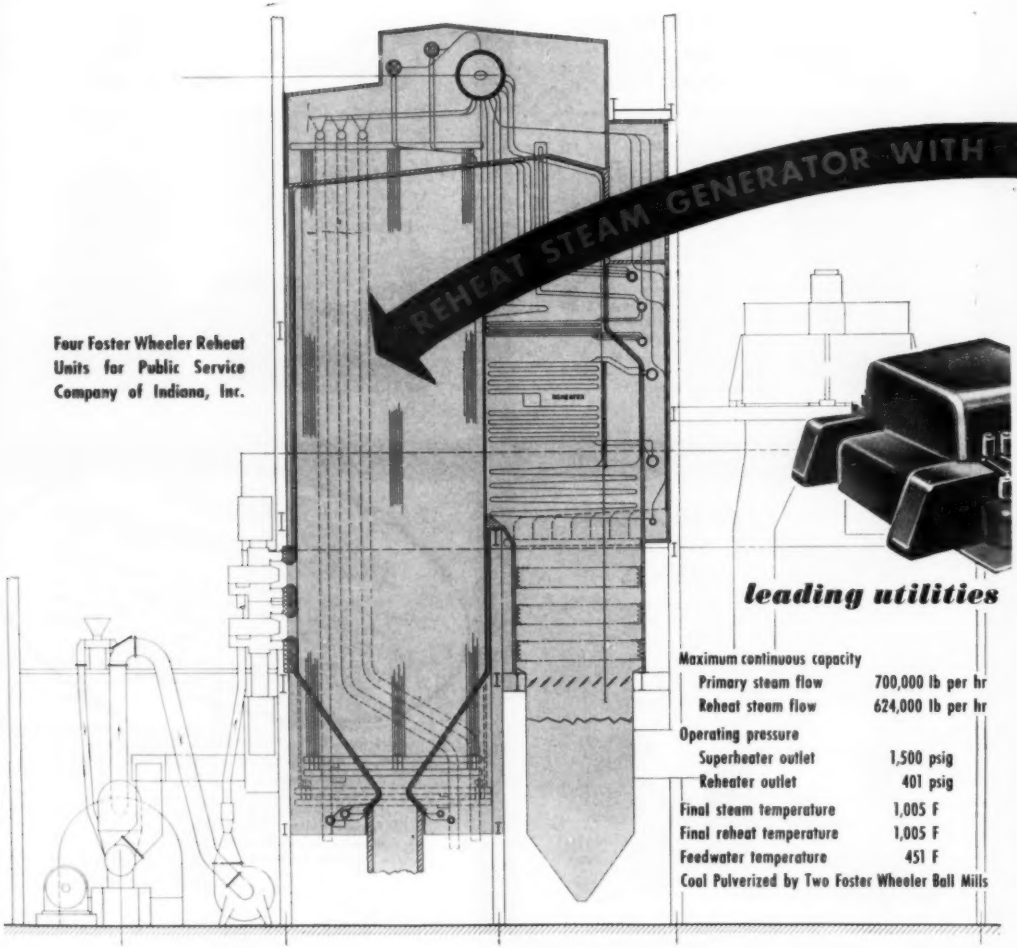
Address .....

City ..... State ..... A-3500

A-C ALLIS-CHALMERS

**Pioneers in Power and Electrical Equipment from Generation through Utilization**

# *Integrating*

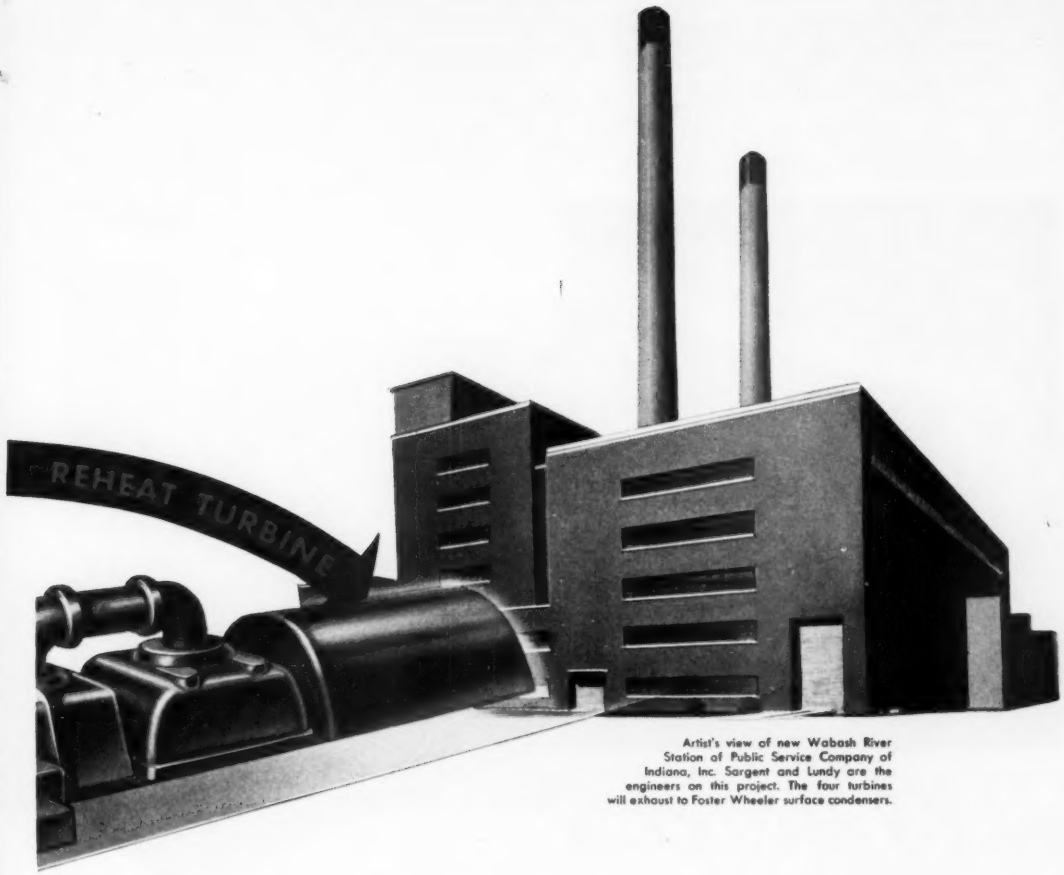



Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

***leading utilities***

| | |
|---|---|
| Maximum continuous capacity | |
| Primary steam flow | 700,000 lb per hr |
| Reheat steam flow | 624,000 lb per hr |
| Operating pressure | |
| Superheater outlet | 1,500 psig |
| Reheater outlet | 401 psig |
| Final steam temperature | 1,005 F |
| Final reheat temperature | 1,005 F |
| Feedwater temperature | 451 F |

Coal Pulverized by Two Foster Wheeler Ball Mills




Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

## *are ordering Foster Wheeler reheat steam generators*

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

The reheat steam generator illustrated is designed with a combination radiant and convection superheater and an all convection reheater. The chief advantages of this type of Foster Wheeler reheat steam generator may be listed as follows:

- complete freedom from furnace slagging is assured because furnace can be designed to suit fuel characteristics rather than reheat cycle duty requirements
- permissible wider selection of fuel of varying slagging characteristics
- location of the reheater deep in the convection zone assures safer metal temperatures during all starting, shutting down, and emergency operating conditions

This design also incorporates such features as:

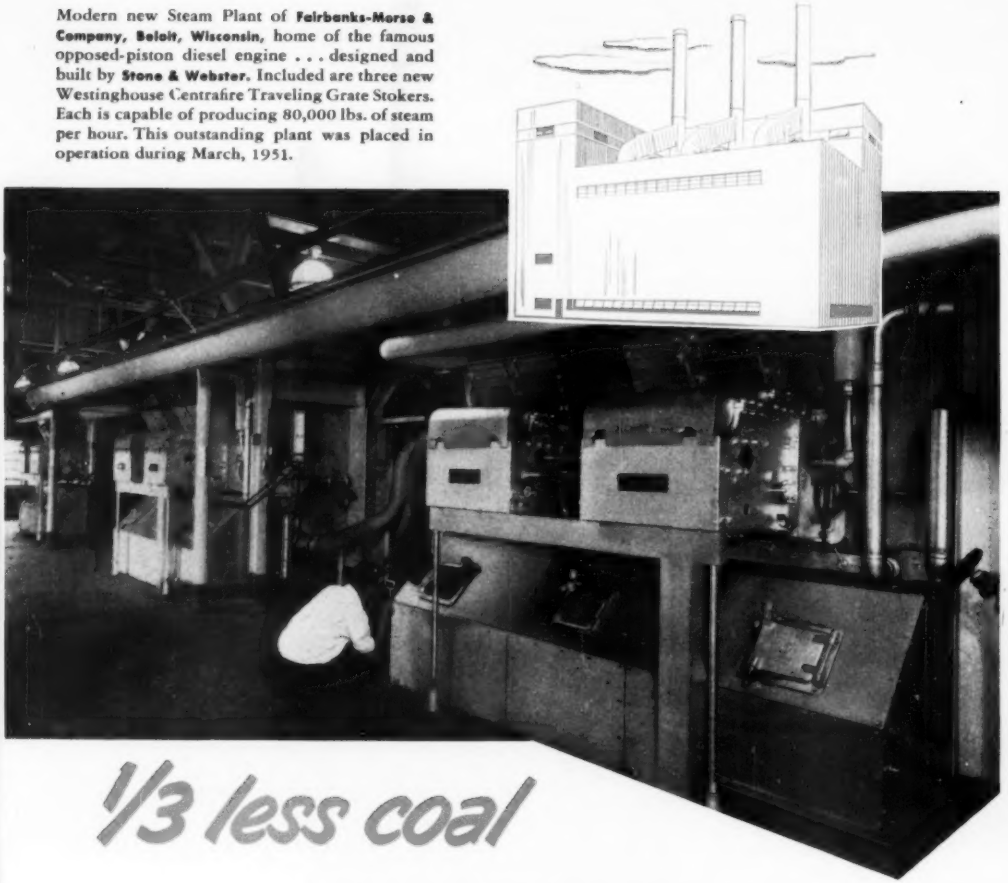
- complete drainability of all superheating and reheating surfaces essential to quick and normal starts
- wide range of precise control of final steam temperature
- fully independent means of controlling primary and reheat steam temperatures.

These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

**FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.**

**FOSTER WHEELER**

Modern new Steam Plant of **Fairbanks-Morse & Company, Beloit, Wisconsin,** home of the famous opposed-piston diesel engine . . . designed and built by **Stone & Webster.** Included are three new Westinghouse Centrafire Traveling Grate Stokers. Each is capable of producing 80,000 lbs. of steam per hour. This outstanding plant was placed in operation during March, 1951.



# 1/3 less coal

## with same load

Three Westinghouse Centrafire® Stokers with Traveling Grate, installed at the new Fairbanks-Morse Steam Plant, are establishing an impressive record of efficient and economical operation. Previous stokers operating under identical temperature and load conditions burned approximately 50% more coal than now is required by the new Westinghouse Centrafire.

Each pound of coal now produces more steam due to more complete combustion with a minimum of excess air. Accelerated response to changing steam loads makes operation easy. Requirements for operating and maintenance personnel have been cut considerably.

You can have the operating economy . . . flexibility . . . and reliability of a Westinghouse Stoker with any boiler of your choice. To get the full story, phone your nearest Westinghouse Stoker Application Engineer, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50533

YOU CAN BE SURE . . . IF IT'S
**Westinghouse**
**STOKERS**

NONPAREIL
TRADE MARK
Turbine Oil

# For economy in the long run

In the case of two 12,500-KW turbines serving a midwest utility, the "long run" already has covered fifteen years. During that period, the original fills of NONPAREIL Turbine Oil have maintained an acidity below .10 mg. KOH/gm., with never any need to remove the oil for treating or for cleaning of the turbine lubricating systems. That's lubrication economy!

There's no time limit on the "long run," however, when NONPAREIL Turbine Oil is used. A written guarantee—given with each fill of NONPAREIL—is your assurance that it will last as long as your turbine.

For economy in your own turbine lubrication, make your next fill NONPAREIL. Let a Standard Oil lubrication specialist show you the facts, including service records covering up to twenty-three years continuous operation of NONPAREIL Turbine Oil. Contact your nearest Standard Oil Company office. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.

**STANDARD OIL COMPANY** STANDARD *(Indiana)*

# Longer bearing life on the "milk run"

Here's evidence of the superior lubrication that a midwest milk processing plant is getting through the use of STANOLITH Grease No. 42. This pump arbor and its anti-friction bearings have been run for a year under conditions of extreme dampness . . . yet there is no appreciable wear, no corrosion.

High maintenance costs and frequent replacement of bearings in both electric motors and pumps had been a direct result of excess humidity in the plant, until a Standard Oil lubrication specialist recommended the use of STANOLITH. After a test run, it was adopted throughout the plant. Now, after a full year of operation, STANOLITH Grease No. 42 has meant a 50 percent reduction in bearing replacements. Corrosion troubles have been eliminated.

STANOLITH's extreme resistance to water has payed off for this user. For your own application, STANOLITH's heat-resistant properties may be most important. Why not discuss the problem with your own Standard Oil lubrication specialist? Just call your local Standard Oil office for his service. Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois.

**STANOLITH**
TRADE MARK
**Greases**

## What's your problem?

**R. L. Hansen**, of Standard's Green Bay office, is the lubrication specialist who recommended STANOLITH Grease No. 42 and helped this processor make important savings.

He and other lubrication specialists are located throughout the Midwest. They are ready to give you prompt and expert attention. If you have a lubrication problem, the lubrication specialist nearest you is the man to see.

He has been specially trained for his job in Standard Oil schools, and in addition, he has plenty of practical experience which qualifies him to give you thorough and reliable service. A phone call to the nearest Standard Oil office is all that's necessary to place him at your service. When he calls, ask him to discuss with you the performance records of the following fine products:

**STANOIL Industrial Oils**—This general-purpose line of oils provides cleaner operation of hydraulic units and supplies effective lubrication in compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

**CALUMET Viscous Lubricants**—On open gears and wire ropes, these greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of gears, better internal lubrication of wire rope.

**STANDARD OIL COMPANY** (Inaiana)

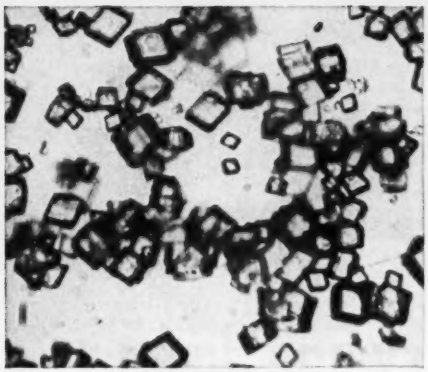
STANDARD

ALLIS-CHALMERS

# No. 26 Series

ORGANIC SLUDGE DISPERSIVE

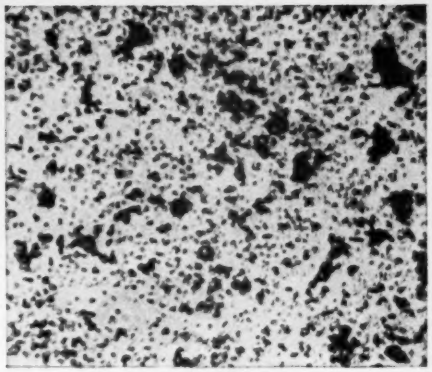
# Controls Sludge-Scale



500X

**UNTREATED**

Note large crystal size



500X

**TREATED**

Inhibited crystal growth and dispersion keep sludge fluid

BOILER SLUDGE CAN FORM SCALE . . . because of its inherent tendency for adhering to heat transfer surfaces.

The dispersive property of Allis-Chalmers No. 26 Treatment prevents crystal growth and produces a fluid sludge, readily removed by blowdown.

To you, the engineer, this means cleaner boilers — boilers that seldom if ever require turbining or other forms of cleaning. No. 26 Treatment does not soften the water, but it can be mixed with softening chemicals (if desired) without reducing its effectiveness as a sludge conditioner. This simplifies its application and reduces your investment in feeding devices.

**A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 26 Series organic sludge treatment is available in our bulletin number 28X7543. (Coupon below for your convenience.)**

**Allis-Chalmers**
**Milwaukee 1, Wis.**

Gentlemen:
Please send me Bulletin 28X7543.

Name .....

Title .....

Company .....

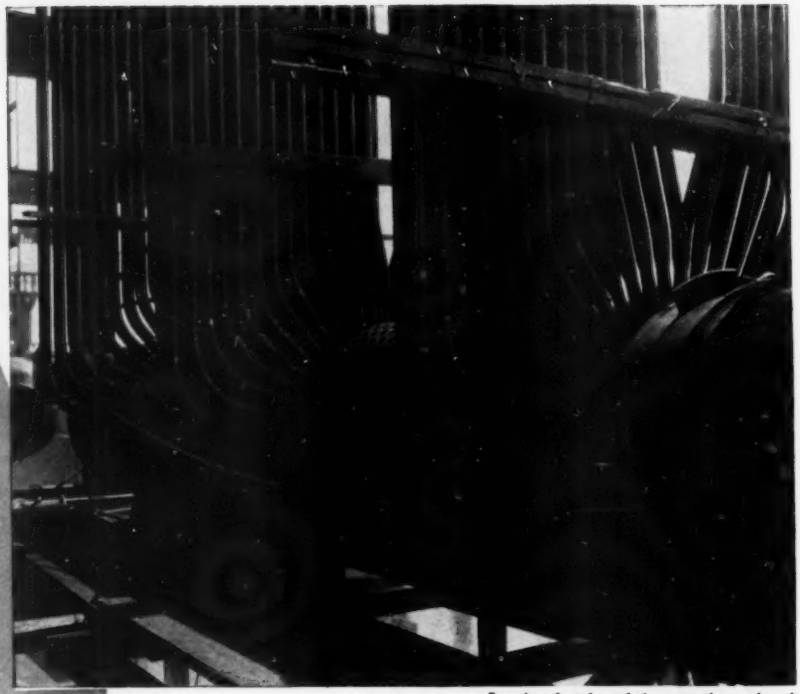
Address .....

City ..... State ..... A-3469

# ALLIS-CHALMERS

## Water Conditioning

✓EQUIPMENT ✓CHEMICALS ✓ SERVICE



*Swaging the tube ends increases the number of tubes that can be safely inserted in the drums.*

# Easy to swage down, Easy to expand... ELECTRUNITE BOILER TUBES

**REPUBLIC STEEL CORPORATION**

**STEEL AND TUBES DIVISION**

**224 EAST 131st STREET • CLEVELAND 8, OHIO**

*Boilermakers like the uniform rolling-in characteristics of these ductile, scale-free tubes.*

● DUCTILITY is the answer . . . the uniformly high ductility that's found throughout the entire length of every ELECTRUNITE Boiler Tube. It's just one of the plus advantages which result from the ELECTRUNITE Process, in which accurately-rolled steel is cold formed and welded into strong, sound tubing—then is full-normalized to provide uniform grain structure throughout the tube.

That's why ELECTRUNITE Boiler Tubes can be swaged down, yet will roller-expand and bead over with unfailing ease and accuracy every time. It's one more reason why boilermakers who have used them say that no other tubes can compare with modern ELECTRUNITE Tubes for fast, dependable installation.

ELECTRUNITE Tubes last longer . . . require less maintenance, too . . . because of their clean, smooth surfaces, free from trouble-causing scale, scabs and slivers *inside and out.*

Get the facts on ELECTRUNITE Boiler Tubes . . . our free Booklet BT-12 will be sent to you on request.

Republic

REPUBLIC STEEL

ELECTRUNITE

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Original 1500-kva single-ended G-E load-center substation installed on plant roof to conserve valuable floor space.

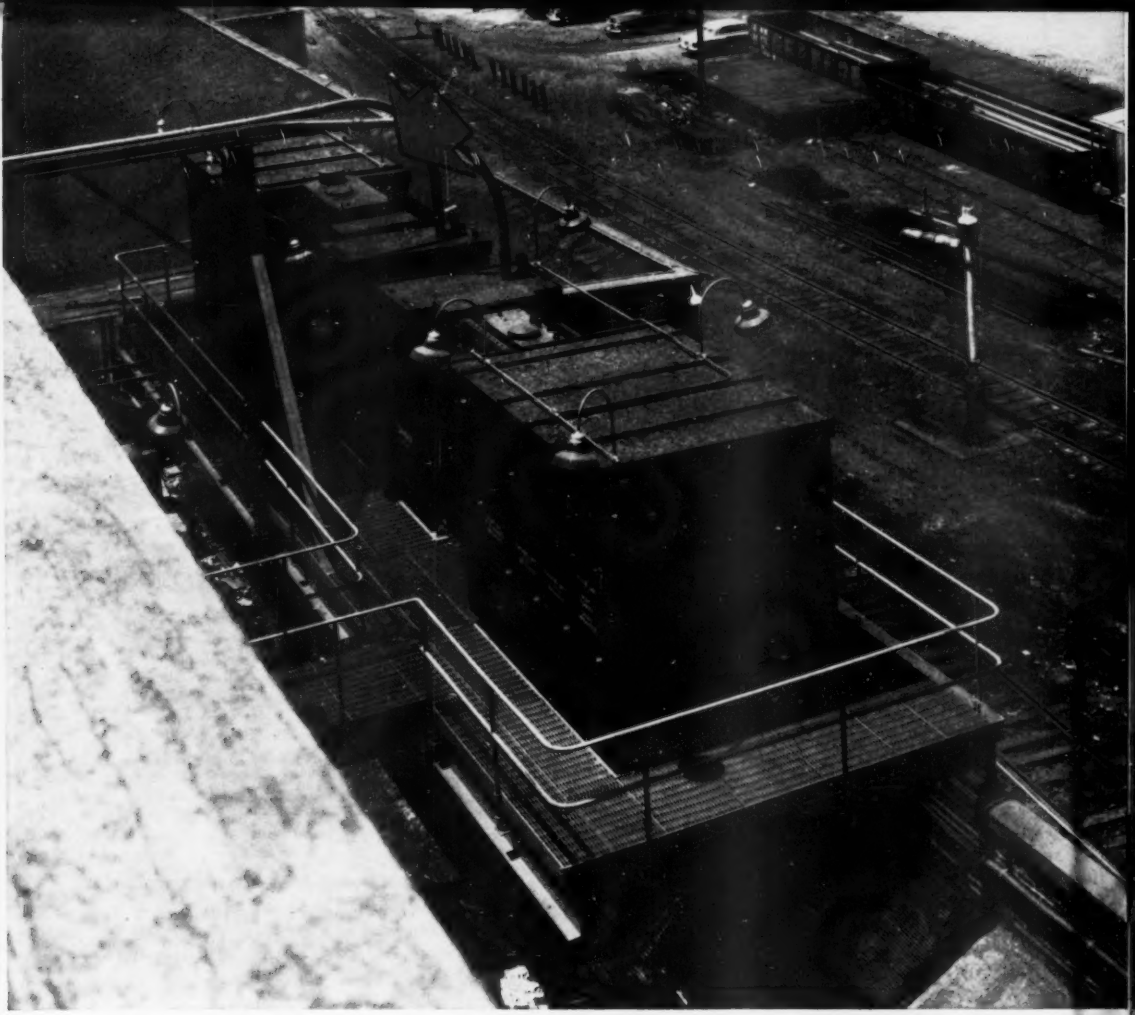
# Foresight that paid off

## POWER DISTRIBUTION SYSTEMS

Some time ago, an Eastern industrial put in a G-E load-center distribution system, knowing that the load served by one of its substations (above left) would probably double within five years. It actually doubled after *one* year.

With any other type distributi· ·, the company would have eventually needed a bigger transformer, taxing the interrupting capacity of existing circuit breakers. Or had the original unit been twice needed size, investment would have been half-wasted for one year. Instead, the company waited until load doubled, then added another "building block" of power of the same economical size, keeping cost-per-kva at optimum. This load area is now fed by two 13,200-volt feeders, one to each transformer, for greater reliability.

What's more, the new substation was installed,



Recent addition of second 1500-kva substation, installed beside original one. Load area is now reached by two high-voltage feeders.

# when power needs doubled

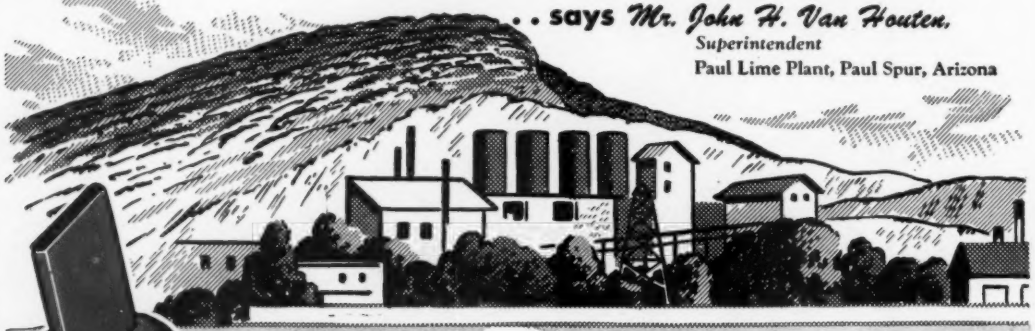
connected and energized without disrupting existing service. *Nothing already done was undone.* Your nearest G-E sales office can help you find the best way to distribute power in *your* plant during these years of expansion. *General Electric Company, Schenectady 5, N. Y.*

854-40

GENERAL ELECTRIC

# "The cost of changing to FUSETRON dual-element FUSES has been paid for more than ten times over in sustained production time"

. . . says *Mr. John H. Van Houten,*
*Superintendent*
Paul Lime Plant, Paul Spur, Arizona



## HERE'S HOW

"Prior to February, 1948 we used ordinary renewable fuses throughout our plant. They gave us short-circuit protection but we lost a great many motors due to single phasing, excessive heating and climatic conditions.

"When a motor goes out in a plant like ours, it costs us a loss in production that is difficult to make up.

"In February, 1948 we changed the whole plant over to Fusetron fuses. On the motors we installed a size to give motor running protection.

"We have completely eliminated motor losses due to single phasing and believe we have better all-around protection than before.

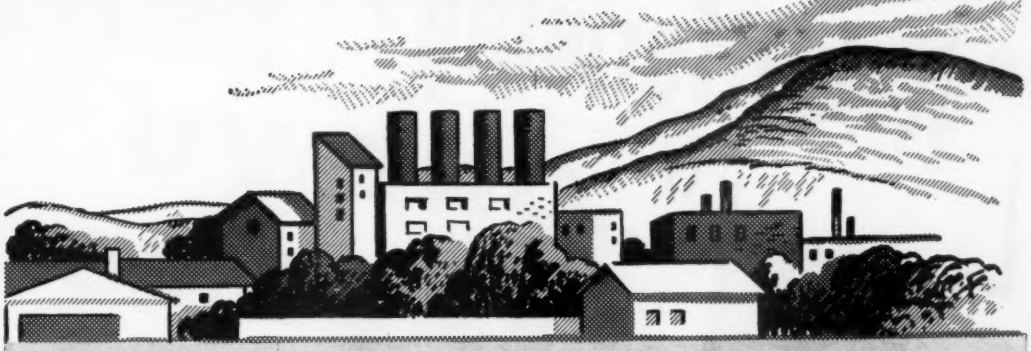
"Our records show that the cost of changing to Fusetron fuses has been paid for more than ten times over in sustained production time.

"What more could we ask?"

*John H. Van Houten*

(Fusetron is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

# You Too, Can Cut Production Losses and Save Many Times Their Cost by Changing to FUSETRON dual-element FUSES



## HERE'S WHY

**FUSETRON dual-element FUSES GIVE 10 POINT PROTECTION**

1. ★Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

★Fusetron fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

## DON'T RISK LOSSES!

One **lost** motor . . .
One **needless** shutdown . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

**USE THE COUPON**

Bussmann Mfg. Co.,
University at Jefferson,
St. Louis 7, Mo.
(Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

Name .....
Company .....
Address .....
City & Zone ..... State .....

1151

# "Are VU Boilers habit forming?"

# "...ONE VU LEADS TO ANOTHER"

## *Have You seen these Headlines before?*

**For months past we have submitted evidence under these ad headlines on one *important point* — those who have bought C-E Vertical Unit Boilers *continue to buy them.* Here are typical cases . . . in industry after industry:**

**An Electric Utility Company** ordered its first VU in 1941. In 1945 it ordered a second VU for a different plant. For another of its plants one unit was installed in 1946 and two more in 1947. In 1949 a VU was installed in a fourth plant, and in 1950 one was installed in a fifth plant. A total of seven boilers in five different plants.

**An Oil Company** ordered its first VU Unit in 1937. In 1941 another was installed and still another in 1950. For another of its plants two units were ordered in 1942 and a third in 1947.

**A Paper Company** installed its first VU Unit in 1947. Two more VU Units were ordered in 1948 for two of its other plants. In 1950 still another was installed in one of the same plants.

## COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

# "One VU can start a family"

# "...they keep coming back for more!"

**A Steel Company** now has a total of fourteen VU Boilers in four different plants. Starting with an installation of two units in the early thirties, it has reordered six times. The most recent installation of two units at one of its plants was completed in 1948.

**A Textile Manufacturer** ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another textile company installed one unit in 1945, a second in 1949 and has just ordered another VU Unit.

**An Automobile Company** installed its first VU Units (2) in 1947. Two more were ordered for another of its plants in 1948; then three more units for a third plant in 1949 and two more for still another of its plants in 1950.

**A Sugar Company** ordered two VU Boilers for one of its plants before the war. In 1946 it ordered a VU for a second plant. And in 1950 another VU was installed in this same plant.

**An Aluminum Company** is another consistent buyer of VU Units. Since installing its first VU in 1940, it has reordered four times, and now has five C-E Vertical-Unit Boilers in service.

**A Chemical Company** ordered two VU Boilers in 1939. In 1946 five more were ordered for three of their other plants. In 1949 two more were ordered for one of these same plants, and in 1950 two more units for a fifth plant. In 1951 three more units were ordered for still another plant — thirteen units for six plants in twelve years! B-532

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Here's just one of the many efficient, economical Eagle-Picher Insulations. It's Eagle-Picher one-coat, all-purpose cement—a revolutionary new product that combines insulating and finishing materials ...that goes on in one easy-to-apply coat.

It gives your equipment highest possible thermal efficiency... cuts operating costs by saving fuel... and helps to provide perfect, precise control on temperatures.

Whatever your requirements... there's an Eagle-Picher Insulation that can fit your needs. Find out about them right away!

**THESE EAGLE-PICHER PRODUCTS CAN SAVE YOU MONEY ...POWER...TIME**

*Insulating Felts* • *Supertemp Blocks* • *Blankets* *Loose Wool* • *Pipe Covering* • *Stalastic* *Insulseal* • *Insulstic* • *Swetchek* • *Finishing Cements* • *Insulating Cements* • *Fireproofing Cement* • *Diatomaceous Earth Blocks*

**EAGLE-PICHER ONE-COAT, ALL-PURPOSE CEMENT!**

A combination insulation and finishing material for temperatures to 1000 F. It's quick setting, rust-inhibitive... has light color, smooth surface, negligible shrinkage. It has exceptional adhesive qualities on ferrous metals and insulation materials. And it's unaffected by rain or moisture after it sets!

EAGLE EP PICHER

**THE EAGLE-PICHER COMPANY** • *General Offices: Cincinnati (1), Ohio*

*Insulation products of efficient mineral wool — for a full range of high and low temperatures.*

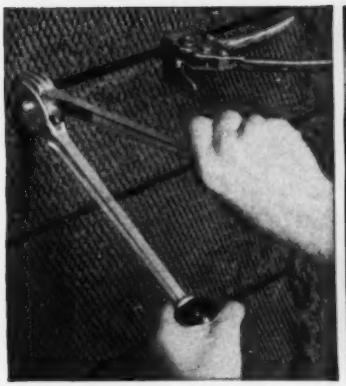
*Technical data on request.*

*Since 1843.*

2172 B1

*These efficient, versatile insulations "team up" to give perfect insulation for every major application*

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Mineral Wool Blankets, Supertemp Blocks, Diatomaceous Earth Blocks and Earth Fill, and Super "66" Cement. They work effectively to give your equipment highest possible thermal efficiency . . . cut operating costs by saving the maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.



**EAGLE-PICHER MINERAL WOOL BLANKETS**

These blankets satisfy the need for a convenient method of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured between flexible metal fabric. Outstanding physical and chemical stability enables Eagle-Picher Blankets to resist water, steam, corrosive fumes and normal vibration.

**EAGLE-PICHER SUPERTEMP BLOCKS**

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700 F. Conductivity at 512 F. approximately 0.53 . . . all standard sizes, from 2" x 18" to 12" x 36" in thicknesses from 1" to 4".

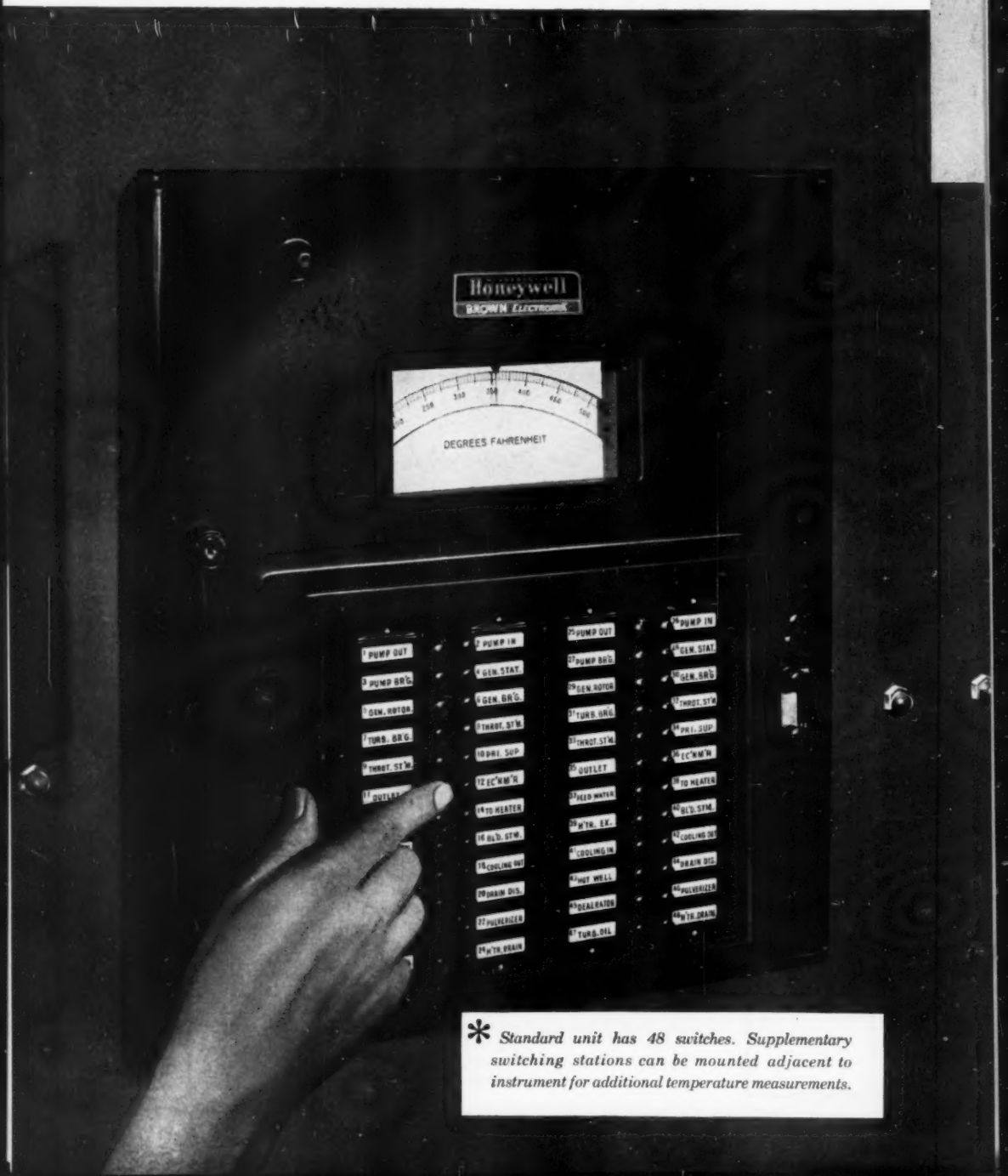
**EAGLE-PICHER SUPER "66" INSULATING CEMENT**

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers approximately 55 sq. ft. —1 inch thick. Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800 F. Reclaimable when used on equipment whose temperatures do not exceed 1200F.

*Eagle-Picher, as a member of the Industrial Mineral Wool Institute, urges that you look for this label. It is a certification by the manufacturer that his mineral wool product conforms to Commercial Standard CS 117-49 as issued by National Bureau of Standards, U.S. Department of Commerce in cooperation with the Industrial Mineral Wool Institute, New York, N.Y.*

MINNEAPOLIS Honeywell
BROWN INSTRUMENTS

**. . . Symbol of Simplified Operation and Maintenance**




* *Standard unit has 48 switches. Supplementary switching stations can be mounted adjacent to instrument for additional temperature measurements.*

# *Push the buttons*

## READ THE TEMPERATURES

**(from one central location)**

**. . . with the**

# *Electronik*

## PRECISION INDICATOR

From central panel board to the farthermost areas of your plant, the *ElectroniK* Precision Indicator can give you accurate temperature readings of 48 (or more) pieces of equipment . . . without moving a step!

A simple push of a switch-button instantly and accurately "tunes" you in to a specific location. Button stays in until another is pushed . . . permitting logging of temperatures, when required. Just install thermocouples at the points from which you desire temperature readings and connect them to the instrument.

The *ElectroniK* Precision Indicator has a calibrated accuracy within $\pm 1/5\%$ of scale span for spans of 10 mv or greater . . . within $\pm 0.020$ mv for spans less than 10 millivolts.

The sensitivity of the *ElectroniK* Precision Indicator is $1/32$ of $1\%$ of scale span for spans in excess of 16 millivolts and 0.005 mv for spans less than 16 millivolts.

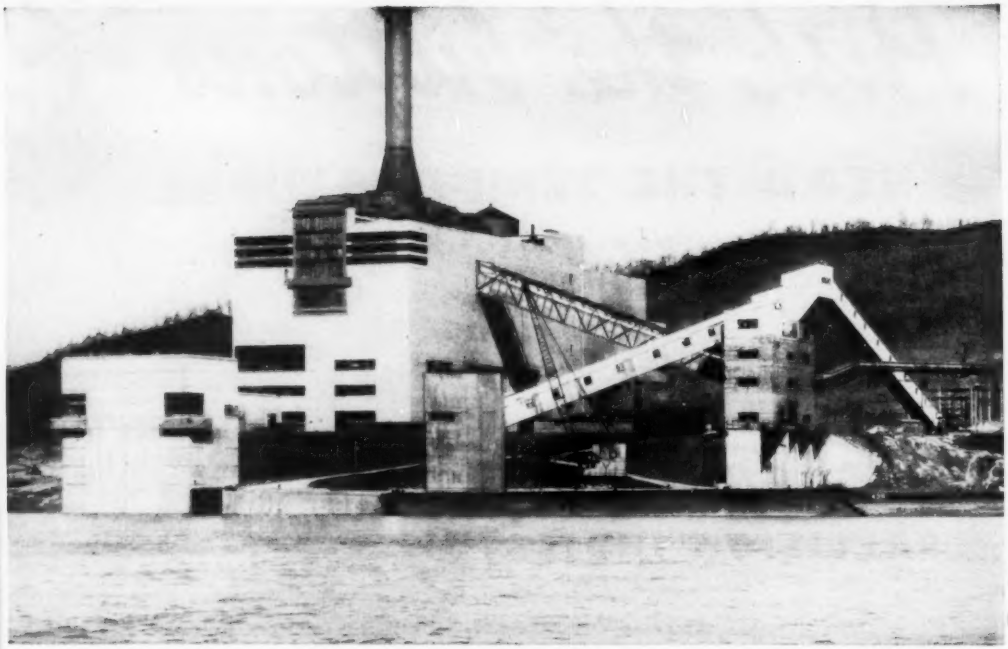
Available in universal case for flush or surface mounting. Dust and moisture proof.

For detailed information write for Specification Sheet 176 or call your local Honeywell engineer . . . he is as near as your phone. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS
**Honeywell**
*Brown Instruments*

***Partial List of Users***

E. I. du Pont de Nemours & Co.
Baldwin Locomotive Works
General Electric Co.
Niagara Mohawk Power Co.
Argonne National Laboratories
Buffalo Niagara Elec. Corp.
Philadelphia Electric Co.
Texas Electric Co.
West Penn Power Company
Public Service Co. of Northern Illinois
Wisconsin Electric Power Co.
Hope Natural Gas Co.
Stancal Asphalt & Bitumuls Co.
Allison Division of G M C
Curtis Wright Corp.
Armco Steel Corp.
Texas Company
Shell Oil Company
International Harvester Co.
Esso Standard Oil Co.
Boren Clay Products
Valentine Firebrick Co.
Sun Oil Co.
Philco Corporation
American Thermos Bottle Co.
Pontiac Motors Div. G M C
Norwich Pharmaceutical Co.
Purdue University
University of Minnesota
Tufts College
Great Atlantic & Pacific Tea Company
Packard Motor Car Co.



# Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

### HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

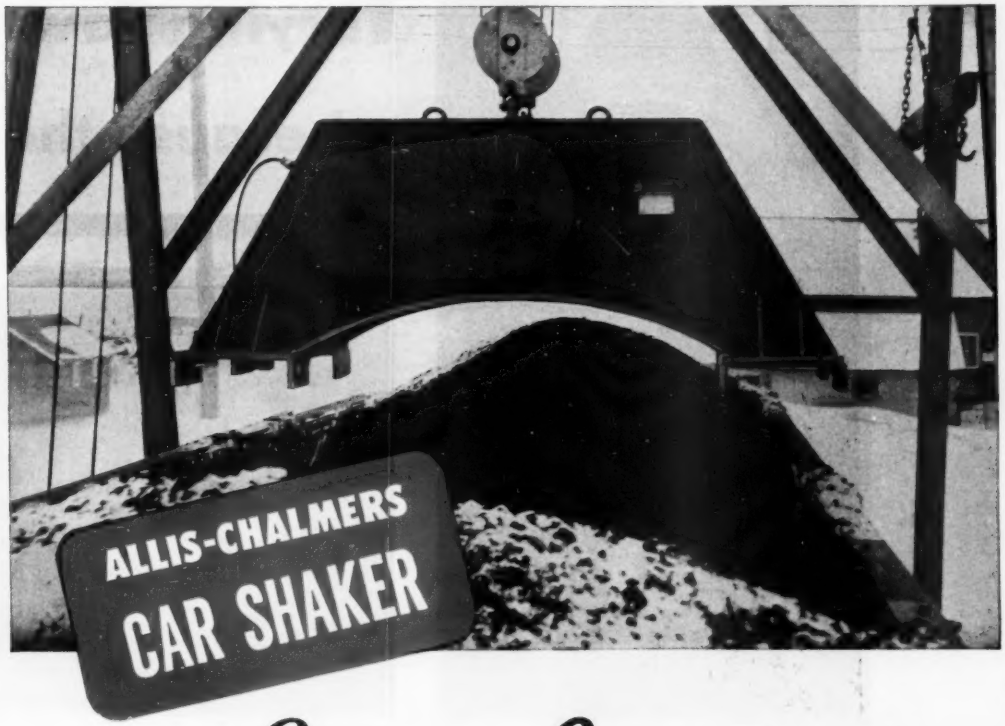
Z.1.1

**WORTHINGTON**

**WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES**

Feed Water Heaters · Steam-Jet Ejectors · Boiler Feed Pumps · Water Treating Equipment · Steam Turbines · Surface Condensers

# FAST UNLOADING




## ...and Sturdy Construction

BESIDES BIG SAVINGS in man-hours and demurrage costs, operators report savings in maintenance and downtime with Allis-Chalmers car shakers. And no wonder! Allis-Chalmers has designed these units for long, dependable service without trouble. For example:

- Shaker body is one-piece, all-welded structure made of 1 in. thick reinforced steel plate and stress-relieved to eliminate welding strains.
- Motor and drive are totally enclosed within shaker body, protected from weather and accidental injury. Motor is mounted in a special cradle base and protected from vibration damage with multiple shear mountings.
- Extra large bearing — 11⅞ in. outside diameter. Long bearing life! Heavy duty shaft arranged for hydraulic bearing removal.

Get more facts about how Allis-Chalmers car shakers can save money in your operations. Call the A-C representative in your area. Allis-Chalmers, Milwaukee 1, Wisconsin.

**Car Shakers Promote Safety to Personnel!**

**ALLIS-CHALMERS**

Allis-Chalmers Mfg. Co.
Milwaukee 1, Wis.

Please send my copy of Car Shaker Bulletin 07B7221A.

Name .....

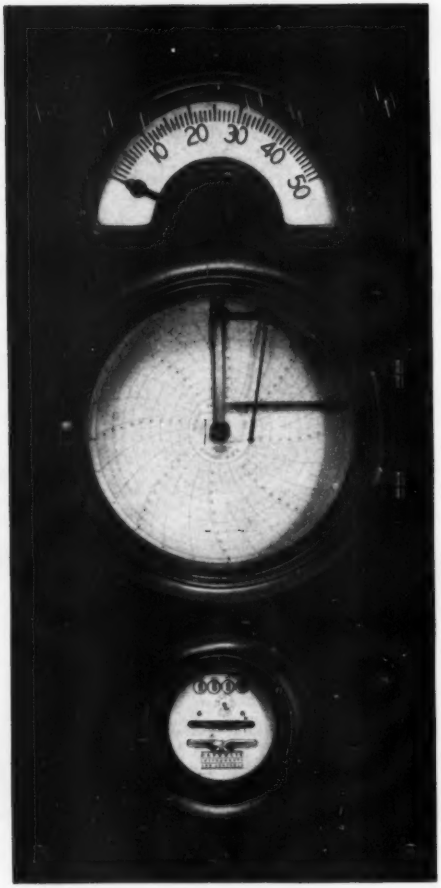
Title .....

Firm .....

Address .....

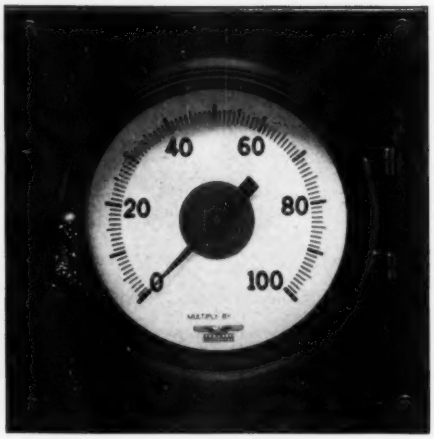
City ..... State .....

A-3468




Indicator-Recorder-Integrator

# Varying flows because the




Indicator

**The Republic** flow integrator, being of the modified watt-hour type, totalizes continuously —not intermittently. It operates independently of the recorder and its accuracy is not dependent on or affected by any clock mechanism or mechanical action.

The Republic meter is, on this account, peculiarly fitted to follow all changes in flow rate and accurately measure highly fluctuating flows.

## ALL TYPES OF FLUIDS

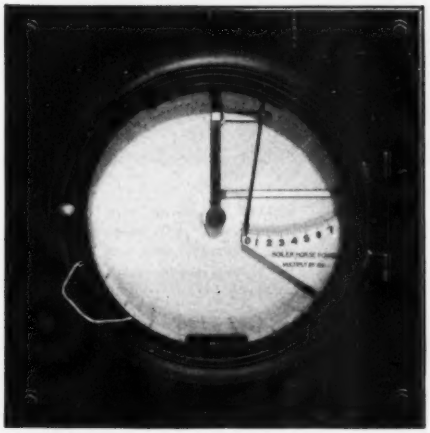
Republic electric type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 5,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator—are of the remote reading type and can be located any distance from the point of flow measurement.

## ANY COMBINATION

While each Republic reading instrument is standard in design and construction each is especially calibrated for the particular flow measurement for which it is specified. Any reading instrument, indicator, recorder or integrator, may be obtained separately or in any

# are accurately totalized

# integrator is continuous



Recorder

Integrator

combination desired, making possible the highest degree of flexibility in plant use.

### SIMPLE IN OPERATION

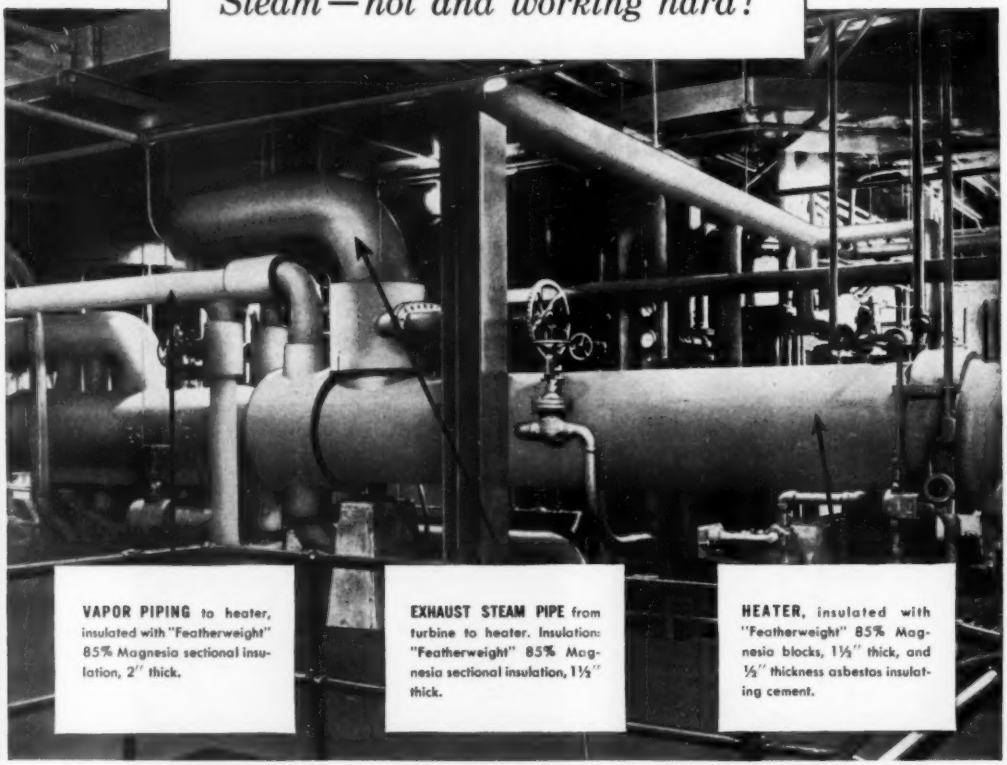
The Republic electric meter is the only flow meter commercially manufactured which is strictly electric in its operation. All other types of so called electric meters use the motion of the mercury to move a float or produce a force which is then converted into an electrical value which is in turn transmitted to a receiving or reading instrument. In the Republic meter, the transmitted electrical value is determined directly by the mercury motion, thus eliminating one of the steps in the sequence, and simplifying the mechanism to that extent. Their are no floats, levers, cams, rotating shafts or anything else to interfere with the unimpeded movement of the mercury, which has no work to perform, but merely fulfills the function of making contact.

### NEW DATA BOOK

**Just off the press—a completely new data book describing and illustrating, in detail, the operating features of the Republic Flow Meter and its many applications. Write for your copy of Data Book No. 702—there is no obligation.**

**REPUBLIC FLOW METERS CO.** ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

*Steam—hot and working hard!*


**VAPOR PIPING** to heater, insulated with "Featherweight" 85% Magnesia sectional insulation, 2" thick.
**EXHAUST STEAM PIPE** from turbine to heater. Insulation: "Featherweight" 85% Magnesia sectional insulation, 1½" thick.
**HEATER**, insulated with "Featherweight" 85% Magnesia blocks, 1½" thick, and ½" thickness asbestos insulating cement.

# These Keasbey & Mattison Insulations keep heat on the job—keep heating costs down!

Steam is expensive to produce . . . and far too valuable to waste. That's why "Featherweight"® 85% Magnesia was the insulation used in this large Southwestern utility plant.

"Featherweight" 85% Magnesia gives maximum protection against heat loss—keeps steam "on the job" wherever and whenever it's wanted!

This is but one of thousands of installations of "Featherweight" 85% Magnesia Insulation—on ships, in power plants, in the chemical process and food industries. With a background of more than 60 years' service, "Featherweight" is today one of the most widely used and favorably accepted insulations for temperatures up to 600° F. When used in combination with K&M Hy-Temp Insulation, "Featherweight" 85% Magnesia is efficient and practical for temperatures up to 1900° F.

Ask your distributor, who is also an experienced applicator, for complete information on "Featherweight" 85% Magnesia, or any insulations in the complete K&M line. Or, write us.

**The newest development in thermal insulation: "KaytherM" High Temperature Blocks**

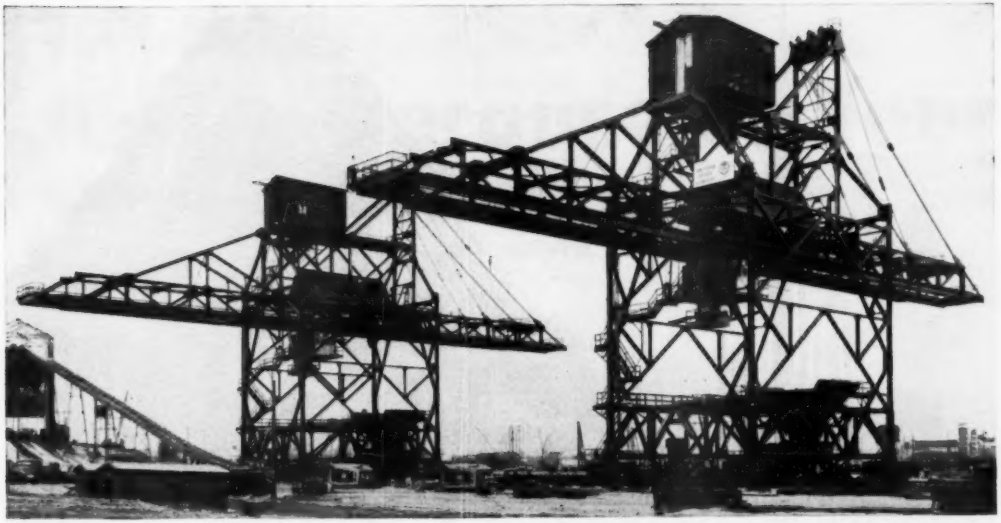
A product of years of research and development! "KaytherM" provides maximum efficiency up to 1500° F. It is molded to size . . . incombustible . . . insoluble in water . . . has exceptional strength and high dimensional stability . . . is light in weight . . . easy to handle . . . quickly applied. Available in flat blocks 6" x 36"; in thicknesses of 1", 1½", and 2".

**KEASBEY & MATTISON**
**COMPANY • AMBLER • PENNSYLVANIA**

*Nature made Asbestos . . .*
*Keasbey & Mattison has made it serve mankind since 1873*

K&M Best in asbestos®

IN CANADA: ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER



# They unload 2000 tons an hour!

## B & O giant unloaders first to use new G-E product

G-E *pumpless* rectifiers give lower cost d-c power than conventional pumped rectifiers because vacuum pumping system is eliminated. This means no vacuum headers, indicators or connections and no condensation pump.

**PUMPLESS RECTIFIERS**

The new Baltimore and Ohio ore facility at Baltimore reduces turn-around time for ore boats and speeds strategic iron ore on its way to the nation's steel-producing centers.

Mercury Arc Rectifiers coupled with adjustable d-c drives are important factors in the highly efficient unloading cycle. Two 1000 kw G-E *pumpless* rectifiers supply the d-c power.

These new G-E *pumpless* rectifiers give continuous low-cost service because they incorporate the latest improvements in design. Vacuum pumps usually required for rectifiers of this great a capacity are eliminated. So are the pumping losses and the water formerly needed to cool the vacuum pumps. All parts are easily accessible for periodic inspection, and any tank can be replaced by a stand-by spare, if necessary.

For information about modern *pumpless*-rectifier conversion to fit your d-c power needs, call or write your nearest G-E sales representative. General Electric Co., Schenectady 5, New York.

**GENERAL ELECTRIC**

324-5

# 26 MILLION TONS of steel scrap "ain't hay"

IT took 57,000 tons of steel to build the Empire State Building in New York. That's about one-tenth of one percent of the tonnage of scrap required to produce the new steel demanded for America's defense and civilian needs this year.

Half of this scrap is produced by the steel mills themselves. The other half - approximately 26 million tons - must be supplied by the public. That tremendous tonnage is the equivalent of 461 Empire State Buildings - over 1400 carloads of scrap every day of the year.

Right now there is a scrap shortage. It threatens to interfere with steel production. So we appeal to you, as a user of steel and steel products, to do all you can personally to help collect scrap.

Somewhere in your place of business - and even at home - there are things that can be scrapped - worn-out or obsolete machines, pipe, boilers, tools, structural parts, etc., that you'll never use again in their present form. Turn them in through regular channels. Call the nearest dealer and start your scrap on its way to the steel mills - to help America reach its production goal of 105 million tons of new steel in 1951. It is this team-work that will help us win the victory again.

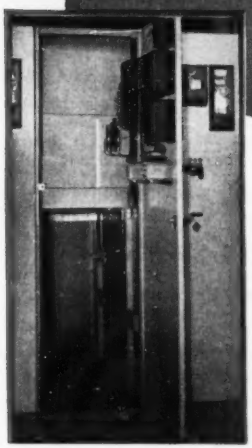
YOUR SCRAP YOUNGSTOWN IS NEEDED

## The Youngstown Sheet and Tube Company

**General Offices--Youngstown 1, Ohio**
**Export Offices--500 Fifth Avenue, New York**
**MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS**

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

# Better Because of Your Operating Experience



Welded-in floor plates provide a smooth rolling surface for your circuit breaker. Guide rails placed at each side of the breaker compartment add rigidity to the structure. A-3385

*Ruptair* is an Allis-Chalmers trademark.

YOU HELPED US design improvements into our switchgear. As the result of your suggestions and operating experiences, we added many new features including more panel space for instruments and relays, welded-in floor plates, wider guide rails, additional protection for wiring and made a more rigid switchgear structure. The new switchgear design is not only more functional, but it's attractive as well. It makes an impressive installation in any plant.

You requested more compartment space for mounting auxiliary equipment. So we designed a new and more spacious compartment for mounting power transformers, transfer bus and similar equipment. It permits you to make a variety of circuit arrangements in a single standard breaker unit.

You wanted to avoid special plant floors for the installation of switchgear. We designed welded-in floor plates to eliminate this requirement and still provide smooth rolling surfaces for the breakers. *Ruptair* magnetic air circuit breaker equipped with built in wheels roll over this steel floor smoothly and easily.

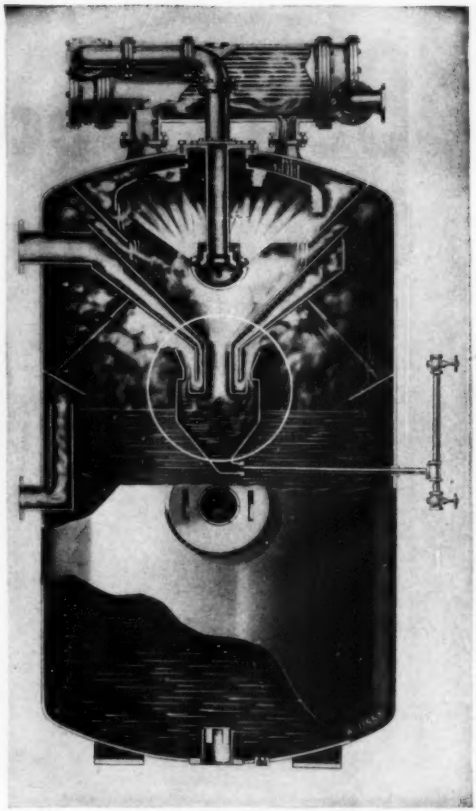
As the result of your experience and suggestions, special wiring is looped where flexing occurs to eliminate excessive wear. Wide full length guide rails on each side of the breaker compartment increase structural rigidity and protect wiring.

Your ideas have helped make standard Allis-Chalmers switchgear safer, stronger and better built. It's modernized to do a better protection job for you.

Standard Allis-Chalmers switchgear is composed of matched units, yet it can be tailor-made to suit your requirements. Get the facts today from your local Allis-Chalmers sales office. Or write direct to Allis-Chalmers, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS** A-C

**First in the U. S. with Metal-Clad Switchgear**



Hard scale, formed on the trays of deaerating evaporator preheaters, is no longer the big problem it used to be.

In a large central station (name on request), the preheaters had to be cleaned every three weeks, and the units were completely shut down at that time from eight to ten hours.

Then Worthington steam-jet deaerators were installed—with a "blowdown" head designed by Worthington engineers. This special head allows the operator to remove harmful deposits at regular intervals *while the unit continues in service.* It also provides for simple and speedy acid cleaning of critical parts, when necessary, without even opening an access door or removing any parts from the unit.

**Compare The "Time-Outs"**

The Worthington unit, given a short blowdown once each shift, stays in continuous operation with maximum deaeration for periods of at least 8 months. When the acid treatment is given at the end of that period, the job is finished in under three hours.

Compare this with the former record. *Then*—8 to 10 hours outage every three weeks and labor by a *crew* of men. Now—with Worthington's blowdown head—operation uninterrupted during regular short blowdown, with a shutdown for acid cleaning only once in almost a year, requiring only one man and three hours!

**Worthington Makes Deaerating Equipment News**

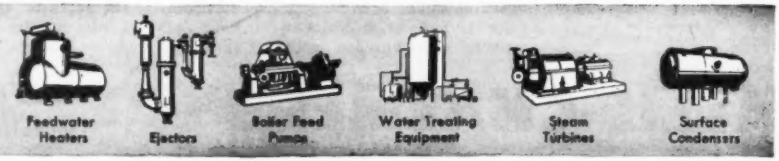
Developments like this, applicable to any deaerators operating under conditions of scaling, are typical of Worthington's engineering firsts in water treating and deaerating equipment.

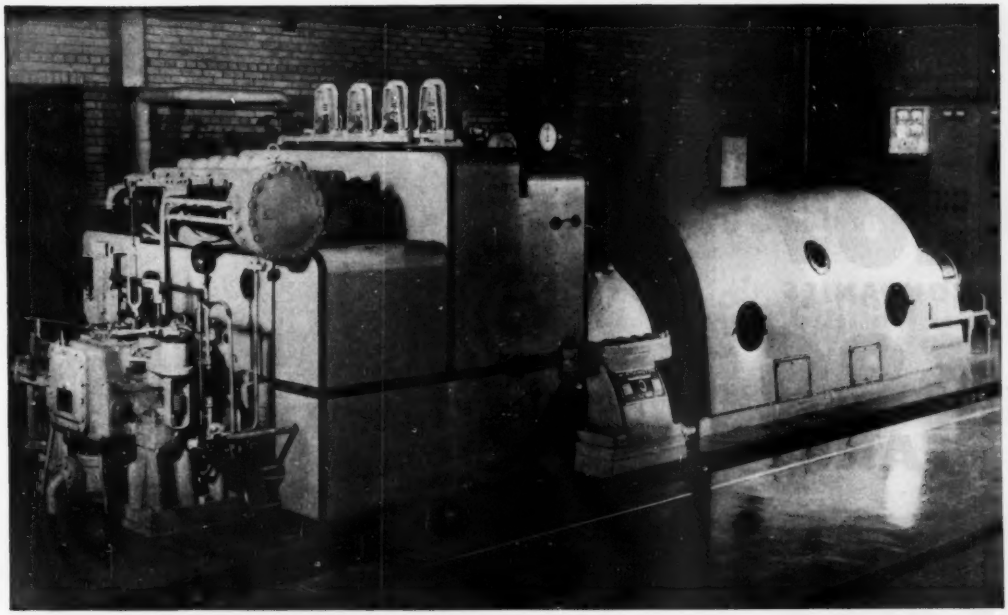
Worthington manufactures all of the equipment needed in a complete water treating installation. For further information on why *there's more worth in Worthington*, address Worthington Pump and Machinery Corporation, Steam Power Div., Harrison, N.J.

# WORTHINGTON

A GREAT TEAM IN STEAM

8.1.3





# Story of an Economy Drive

## How the Worthington Steam Turbine Pays Dividends for the City of Litchfield

What happened at Litchfield, Minnesota, is a clue to a most economical power plant operation.

Originally, the Litchfield municipal power plant consisted of low-pressure boilers, a steam engine and a small turbine-generator unit. The exhaust steam is sold for municipal heating.

Next—a Diesel engine-driven generator was installed. The load grew, and finally, after a careful survey, it was decided to install a 3000-kw Worthington turbine generator and automatically extract steam for heating purposes.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000-kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

**WORTHINGTON**

STEAM TURBINE GENERATORS

T.1.9

A GREAT TEAM IN STEAM

Single-Stage Turbines

Multi-Stage Turbines

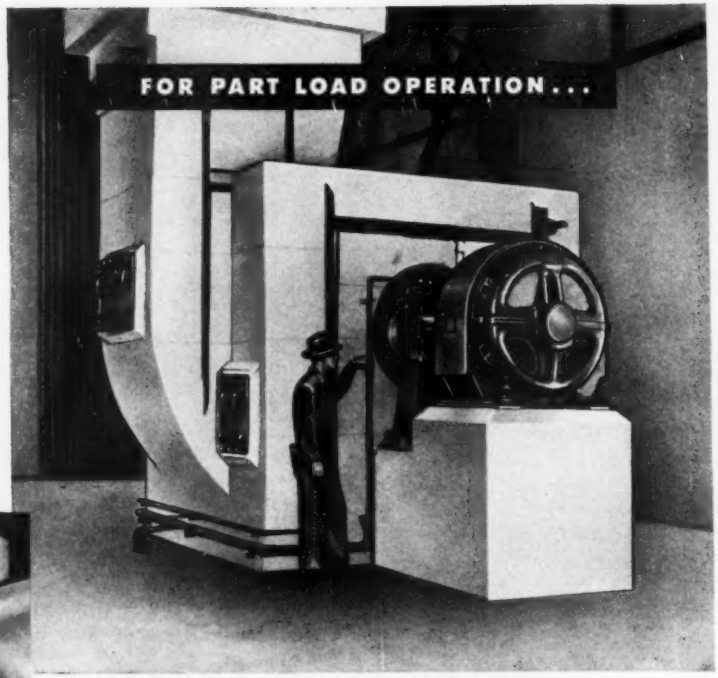
Turbine-Generator Sets

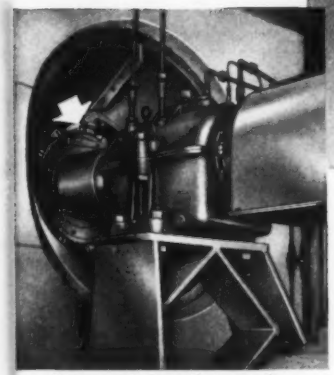
Feed Water Heaters

Boiler Feed Pumps

Surface Condensers

# 207 COMPANIES 686 FANS



Enlargement shows that operating mechanism of the new Sturtevant Vane Control is outside the gas stream. It is free from build-up of fly ash and is readily accessible for inspection.

Write today for
DB 92-810
describing Vane Control.

## 207 COMPANIES ARE NOW USING NEW STURTEVANT VANE CONTROL® FOR 686 MECHANICAL DRAFT FANS

**HERE'S WHY**—Adjustable Inlet Vane Control is the most efficient and economical means of controlling fan output over a wide percentage of capacity. Regulation to exact pressure and volume requirements is instantaneous and permits great power savings when the system is not operating at full rated capacity. A few of these 207 companies are listed below:

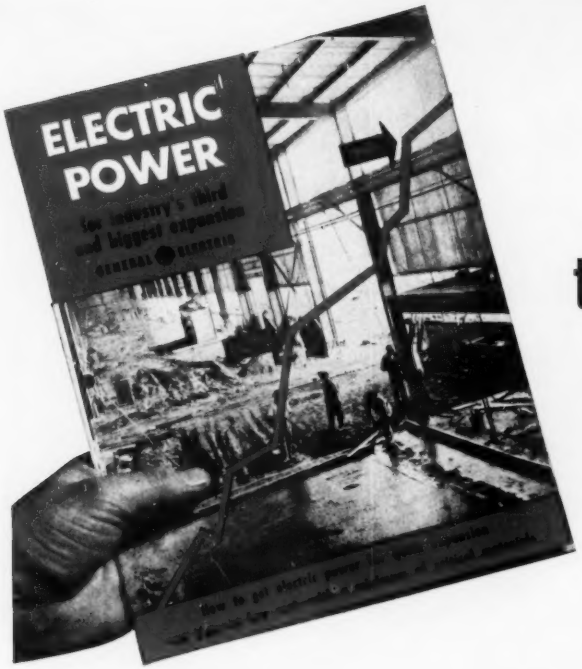
| CENTRAL STATIONS | INDUSTRIAL PLANTS |
|---|---|
| Alabama Power Company | Aluminum Company of America |
| American Gas & Electric System | American Tobacco Company |
| Cleveland Electric Illuminating Co. | Caterpillar Tractor Company |
| Consolidated Edison Company | The Coca-Cola Company |
| Metropolitan Edison Company | Diamond Alkali Company |
| New Jersey Power & Light Company | Esso Standard Oil Company |
| New York State Electric & Gas Corp. | Lever Brothers Company |
| Pacific Gas & Electric Company | Pratt & Whitney Aircraft |
| Pennsylvania Electric Company | Revere Copper & Brass Incorporated |
| Philadelphia Electric Company | United States Rubber Company |

Full information on power savings through the use of Vane Control with forced or induced draft fans, industrial fans and centrifugal compressors is given in DB 92-810. For a free copy, write Westinghouse Electric Corp., Sturtevant Division, 161 Damon Street, Hyde Park, Boston 36, Massachusetts.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING *Air* TO WORK

J-80236




# Here's your guide to quick economical power expansion

## Tells how to:

- Get more power for expanding production.
- Modernize old electric systems easily and economically.
- Save months in getting urgently needed electrical equipment.
- Cut equipment and installation costs.
- Conserve vital materials and manpower.
- Simplify planning, purchasing and engineering problems.
- Plan economically to provide for future growth.
- Guard against power shut-downs and lost production.
- Provide greater protection for your plant and safety for personnel.

## *Just off the press* — a new booklet that tells how to plan your plant electrical system to meet today's need for more production — at low cost!

If you're planning for plant expansion—if you want more electric power to keep machines operating at top capacity—if you recognize the need for a more modern, more dependable electric power system—here's a booklet that may mean thousands of dollars to you in over-all equipment savings and lowered production costs.

It tells how hundreds of plants today are expanding and modernizing their electrical systems with the latest developments in G-E standardized "packaged" power distribution equipment.

It shows how you can cut corners in getting the equipment you need in the quickest time and with the least trouble. It demonstrates how you can often save through reduction of power losses—how you can plan effectively to meet future needs for years ahead.

This booklet is profusely illustrated with photographs of actual installations—some of them probably applicable to your plant. Send now for your copy—General Electric Company, Schenectady 5, N. Y.

**Section A854-41**
**General Electric Company**
**Schenectady 5, New York**

Please send me a copy of bulletin GEA-5600, "Electric Power—for America's Third and Biggest Expansion."

Name_____

Position_____

Company_____

Street_____

City_____ Zone___ State_____

**GENERAL ELECTRIC**

# 4 More Go On The Line

## AT NEW HAWTHORN STATION, KANSAS CITY

**Over 50 of these pumps have been bought by utilities on their proved performance record.**

NEWEST PLANT OF KANSAS CITY POWER & LIGHT CO. is the Hawthorn Steam Electric Station on the Missouri River. This station, designed with every modern feature for dependability and low cost operation, has an initial capacity of 132,000 kw from two turbines and is already building an addition that will add almost another 100,000 kw from one additional turbine.

The boiler feed pump arrangement, pictured above, consists of four Allis-Chalmers 8" x 8" barrel-type boiler feed pumps with a capacity of 700,000 pounds per hour each at a discharge pressure of 1625 psig. They are driven by 1750 hp, 3600 rpm motors.

The unit now under construction also will be served by Allis-Chalmers barrel-type boiler feed pumps. Three pumps with a capacity of 425,000 pounds per hour at 1815 psig driven by 1250 hp, 3600 rpm motors are now being built.

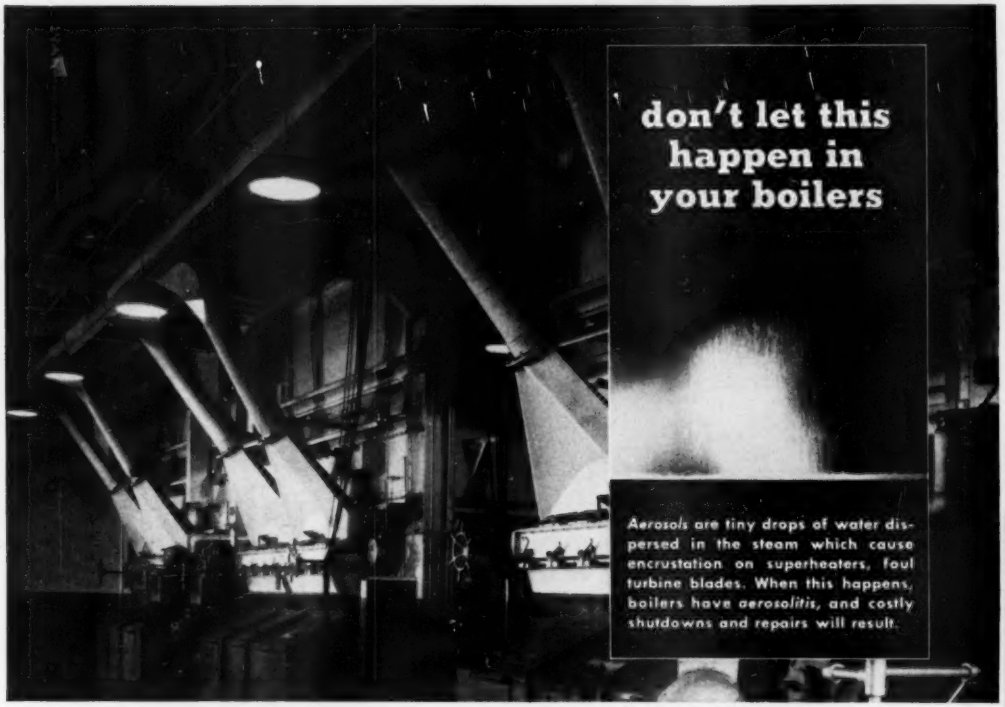
### Engineering Features

Unique engineering features designed to increase reliability and reduce maintenance have been proved in operation. Single-stage, back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half capacity impellers to give the advantages of low NPSH. Expansion joint is brought to the outside of the pump where leakage may be quickly detected and adjustments made without dismantling the pump. No flexible internal members are required to compensate for expansion.

Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control of coordinated design and manufacture.

Get the details on this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3522

**ALLIS-CHALMERS**


don't let this happen in your boilers
Aerosols are tiny drops of water dispersed in the steam which cause encrustation on superheaters, foul turbine blades. When this happens, boilers have aerosolitis, and costly shutdowns and repairs will result.

# prevent aerosolitis

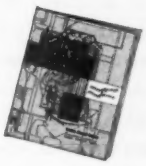
## *with Dearborn improved polyamide anti-foams*

Your healthy looking steam boilers may be suffering from *aerosolitis* . . . the expensive boiler disease.

But *aerosolitis,* more prevalent with some waters than with others, is easy to cure with Dearborn Improved Polyamide Anti-Foams. In addition to inhibiting aerosol formation, Dearborn Improved Polyamide Anti-Foams prevent foaming to produce purer steam . . . eliminate scale formation . . . condition sludge . . . are compatible with other treatment.

If you use steam for power or process, investigate the time and money saving advantages of Dearborn Improved Polyamide Anti-Foams.

**DEARBORN CHEMICAL COMPANY**
**Merchandise Mart Plaza • Chicago 54, Illinois**



### *Write for Bulletins*

**Informative bulletins are available on (1) Dearborn Improved Polyamide Anti-Foams, and (2) Dearborn Industrial Water Treatment and Engineering Service. The coupon is for your convenience.**

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza
Chicago 54, Ill.

Gentlemen: Please send:

☐ Bulletin on Dearborn Improved Polyamide Anti-Foams.

☐ Bulletin on Dearborn Industrial Water Treatment and Engineering Service.

*Name*.....

*Company*.....

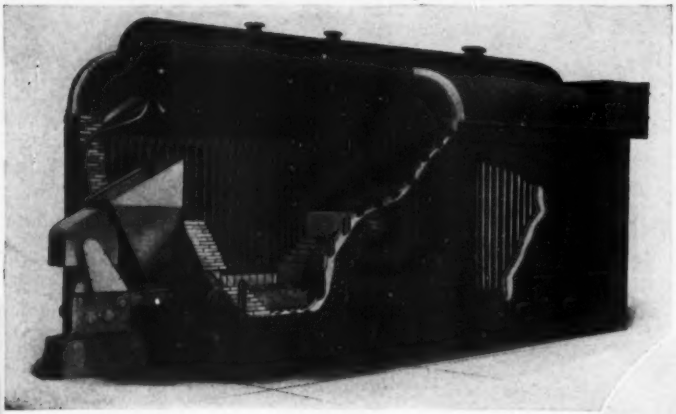
*Position*.....

*Address*.....

*City*.....*State*.....

**Dearborn**
TRADE MARK REGISTERED
**THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES**

# TYPE-VL *A Low Headroom*
## 2-DRUM WATER WALL BOILER

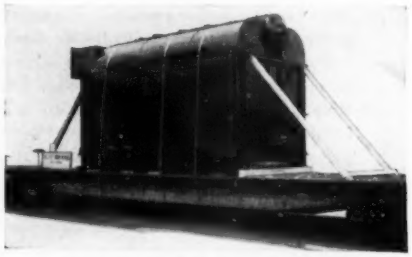


**SHIPPED BUILT-UP IN SIZES TO 300 H. P.**

**Water Wall tube arrangement—1 Downcomer for each 2 Riser Tubes**

### Clean, Quiet, Circulating Water Taken From Top Drum

BACKED by a long experience gained in the manufacture of over 500,000 H.P. of Erie City 2-drum water tube boilers and of thousands of complete built-up boiler units, Erie City has incorporated side wall water cooling as an integral part of a low headroom 2-drum boiler. Outstanding of many features, is the method of obtaining a ring flow circulation, in each side wall element. A downcomer tube is provided for each pair of radiant (riser) tubes in the side wall, which, with two front wall downcomers assure an ample supply of clean circulating water in the water walls at all times. Insulation between riser and downcomer tubes keeps water at lower temperature in the downcomers while heat is rapidly removed from refractory through risers. Write for VL bulletin that clearly describes and illustrates this and many other features.



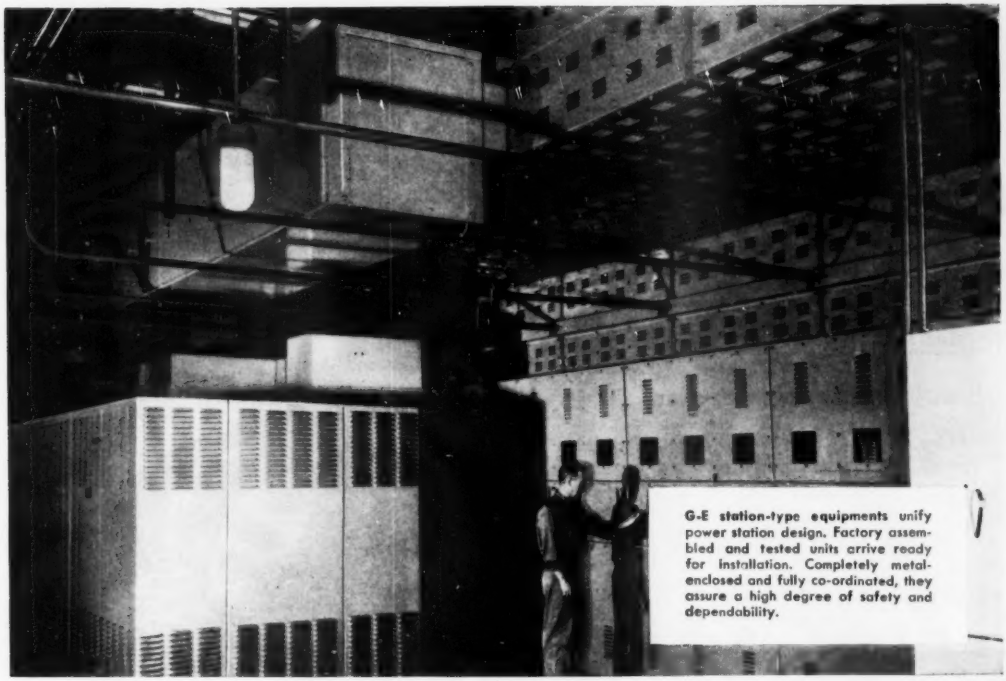
**Shop assembled and shipped as a unit in sizes to 300 H. P.**

COMPLETE STEAM POWER PLANT EQUIPMENT

**ERIE CITY**

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

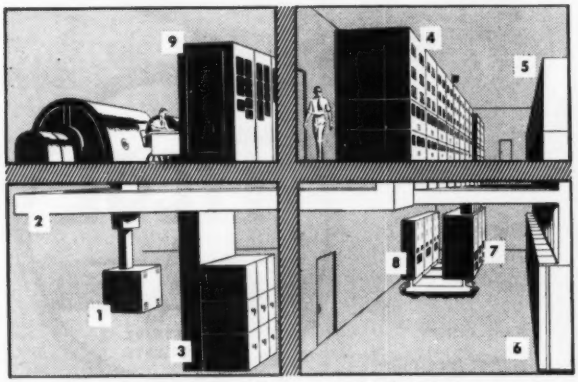
**ERIE CITY IRON WORKS • ERIE, PA. •** *Since 1840*



**G-E station-type equipments** unify power station design. Factory assembled and tested units arrive ready for installation. Completely metal-enclosed and fully co-ordinated, they assure a high degree of safety and dependability.

## FORMULA FOR UNIFIED POWER STATION DESIGN . . .

# Complete project planning with packaged equipment




**Artist's view of typical station switchgear, of which the various components are:** (1) Neutral grounding breaker and resistor; (2) Generator buses; (3) Generator surge and potential transformers; (4) Generator and feeder cubicles; (5) Feeder transfer bus; (6) Feeder cable entrance units; (7) Synchronizing reactors; (8) Synchronizing bus; (9) Duplex control board.

G-E station-type equipments provide the modern method for getting unified power station design. These standardized units readily combine into a compact, integrated system matched to your requirements. Factory assembled and tested, they provide a degree of over-all co-ordination difficult to achieve in any other way.

Standardized "packaged" units include circuit breakers, associated switching equipments and interconnecting buses. Each has been given the large investment in design time and high degree of design refinement warranted by repetitive manufacture. All are completely metal enclosed and fully co-ordinated to assure greater safety and dependability.

For complete information concerning the many advantages of G-E station-type equipments, see your local G-E sales representative, or write the General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

R55-28

# "Tycol Aturbrio Oils have high oxidation resistance... cut turbine shut-downs"

Tycol Aturbrio Oils are unexcelled for long turbine life. They provide resistance to oxidation and protect against corrosion.

Further, Aturbrio Oils have excellent demulsibility properties. Turbine Operators using Aturbrio report minimum wear . . . utmost turbine efficiency . . . greatly decreased maintenance costs.

For complete information, call or write the nearest Tide Water Associated Office.

TYCOL

INDUSTRIAL LUBRICANTS

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TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE - NEW YORK 4, N.Y.

SEND FOR A FREE COPY OF "TIDE WATER ASSOCIATED LUBRICANIA"

# piping repairs *cost more* now!

Crane No. 351 125-Pound Iron Body Globe Valve

**You make fewer of them by using Dependable Quality**

## CRANE VALVES

*...That's why more Crane Valves are used than any other make*

**Preferred for true, tight seating**

For smooth, positive regulation of flow, check Crane quality engineered Iron Body Globes with composition or metal disc. They're easy to operate; easy to maintain. Guide stem under disc assures square seating... true disc travel with minimum vibration. Seat rings are screwed in and can be renewed if necessary.

These rugged valves require little maintenance. Roomy stuffing box with bolted two-piece gland keeps tight stem seal, lengthens packing life. Stem threads are outside valve body, easy to lubricate.

**Ask your Crane Representative to show you how Crane Quality valves and fittings not only give you more dependable piping performance... but cost less in the long run.**

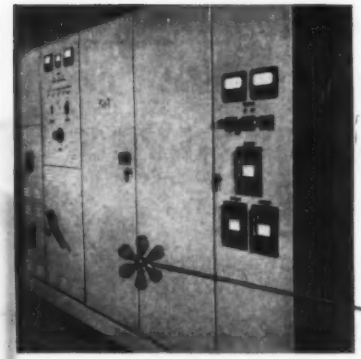
# CRANE CO.

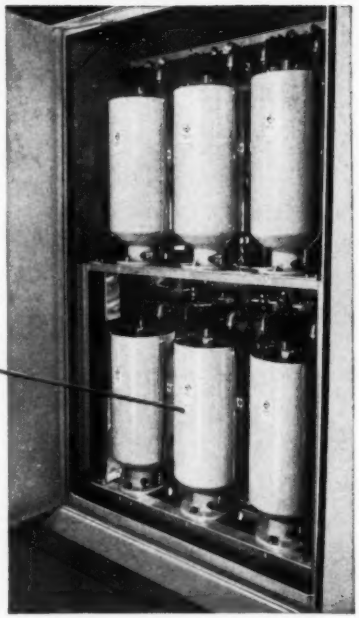
*General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
*Branches and Wholesalers Serving All Industrial Areas*

**VALVES • FITTINGS • PIPE • PLUMBING • HEATING**

# Don't build around obsolete DC supply

## —RETIRE IT NOW!





Modern Allis-Chalmers factory packaged, sealed tube, 500 kw mercury arc rectifier as installed in midwestern industrial plant. Left: "dead-front" compartments for dc feeders, dc metering and cathode breaker, rectifier tubes, and ac control and metering. Right: interior view of mercury arc rectifier tube compartment.

NOW IS THE TIME to retire obsolete converting and generating equipment. As operations expand, this inadequate equipment will become a growing handicap.

Now too — while there is a favorable base for amortization — is the time to consider mercury arc rectifiers for your expansion plans. Let Allis-Chalmers show you how the *modern* mercury arc rectifier can improve your direct current service.

**LOW MANPOWER REQUIREMENT.** With push-button starting and no synchronizing required, attendants are not needed during normal operation. Downtime for maintenance is reduced with no moving parts to lubricate or wear.

**LOW COST OPERATION.** Conversion efficiency is higher at all loads with large power savings during light load periods.

**CONVENIENT INSTALLATION.** Factory packaged, light in weight, and requiring no special foundation, Allis-Chalmers mercury arc rectifiers may be placed right at the load center.

**IMPROVED PLANT OPERATION.** With dc load center installation, distribution distances are cut, dc feeder losses are reduced, and full voltage is available at production equipment.

Whatever your specific direct current needs, Allis-Chalmers builds suitable and truly modern mercury arc rectifiers to meet them.

Sealed tube rectifiers (as shown above) are supplied in ratings from 200 to 1000 kw for lighter duty service. These are commonly used in large buildings, industrial plants and electric haulage systems. Pump evacuated rectifiers are built from 750 kw to the largest ratings required for heavy duty applications.

An Allis-Chalmers representative will be glad to explain in detail how these modern mercury arc rectifiers will improve the operation of *your* direct current system. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3467

**ALLIS-CHALMERS** AC **MERCURY ARC RECTIFIERS**

Power
COMBINED WITH OPERATING ENGINEER

# What's an Engineer?*

YOU CAN WRITE your own ticket, but here's my formula for a real engineer:

First he likes machinery. Almost certainly this trait showed up while he was still a boy. He was hipped on tools and seeing the wheels go round.

By long years of working with machines and reading and thinking about them, he has turned this mechanical birthright into a lot of mechanical skills. He can handle almost any kind of tool or machine you could name.

Yet even all this mechanical know-how isn't enough. As an engineer, he is more than a good mechanic and machine operator. His mind creates, invents, thinks up new gadgets and new hookups to solve his new problems as they arise. And he can turn these bright ideas into things that work.

This real engineer may not be good at higher mathematics, but he does know how to use everyday arithmetic and geometry to get sound answers to his practical engineering problems. He knows how to figure tanks, weights, powers, pressures, efficiencies.

He knows the "line language" of mechanical drawing, can handle drawing board and T-square to picture solid objects in three views. He understands blueprints and can build from them. He can talk to other engineers, and to mechanics, in the picture language of freehand drawing.

Combining several of these talents, he can (with some occasional outside help) design plants and hookups. He is able to supervise their erection and operation with a complete understanding of each step.

This real engineer I am talking about has learned to think far ahead. He has long since considered the new demands the future may impose on him and how he might revamp his plant to meet them. He knows the improved equipment that could be worked into his plans.

In a personal sense this engineer looks ahead to the days when he can grow step by step into a bigger job, so he is already learning how to delegate responsibility without losing his grip on the throttle.

He is well aware that the world moves, that technology advances and keeps getting more difficult. To keep pace he is always reading, observing, conferring, thinking.

The real engineer I am talking about may be no expert accountant, but he understands operating forms, knows how to make estimates and keep costs.

He may be no superman in the business world, but this real engineer can organize his engineering office, keep proper files and records, handle his everyday paper work without confusion. He knows how to write acceptable business letters and how to draft reports that bring action.

To deal effectively with management he has added a bit of "front" to his technical talents. He can stand on his feet, state his views in clear logical language. He acts, talks, thinks, and dresses like a successful department head.

He has learned to deal tactfully with parallel department heads. Even more important, he has learned the more difficult art of being a sound boss by exercising leadership without being either a tyrant or a sucker.

In this last he wins respect by his practical understanding of the job. Holding every man to a high standard of performance, he is likewise a loyal and friendly member of the plant team, a respecter of individual rights—above all, a keeper of promises and a square shooter.

He never holds good men down. Rather, he trains men to step up to higher jobs, maybe even into his own job. Thus he is fair and earns loyalty, also makes it possible for management to give him higher executive responsibilities.

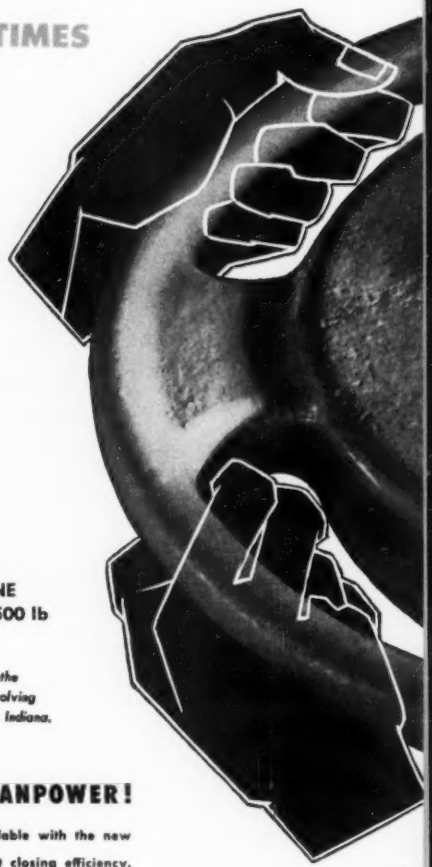
**Phil Swain**

*See letter, "Young India Speaks," on page 5.

# It Gives You the Torque

## Edward Valve IMPACTOR HANDWHEELS

### GIVE YOU FROM 2.8 TO OVER 12 TIMES THE FORCE OF AN ORDINARY HANDWHEEL TO CLOSE VALVES



**It takes three strong men, pulling their hardest, on an ordinary valve handwheel to equal the closing force of ONE man using an Edward 16" Impactor Handwheel. With progressively larger size Edward Impactor Handwheels, the force available to close a valve is equal to six, eight, ten and, yes, *even twelve men.***

**Originated and patented by Edward and improved through the years, the Impactor handwheel is the one most effective means of manually closing a valve so it is absolutely tight against high operating or test pressures in power, petroleum, chemical, marine, or industrial plants. It needs no clumsy expensive gear or toggle construction, or the use of extension levers or cinch bars for actuating.**

**Its space-saving design allows piping designers great latitude in locating valves, walkways and operating platforms.**

**But most important, the Edward Impactor handwheel means sure, fast operation of valves—big or little—in an emergency or under normal operating conditions by a single man. It saves manpower by giving ONE man more power. NOW standard equipment on most 900, 1500 and 2500 lb Edward Valves, 2½ inches and up.**

*The Impactor principle is simple. Two heavy lugs are cast on the underside of the wheel: a sharp turn of the wheel causes these lugs to strike simultaneous blows against a steel cross arm, locked to the stem or revolving EValthrust yoke bushing. Write for full facts, Edward Valves, Inc. 1220 West 145th Street, East Chicago, Indiana.*

### WOMANPOWER BEATS MANPOWER!

**Many smaller size Edward valves are available with the new Impactor Handle (right in photo) for greatest closing efficiency. Design principle is same as Impactor handwheel, and test gages prove it too gives you the torque of six hands or 2.8 times the closing force of an ordinary handwheel. You know the valve is closed absolutely tight with an Edward Impactor Handle.**

FEATURES LIKE THIS SAVE YOU MONEY AND WORK . . . .
That's why it pays to specify Edward Valves.

# of SIX Hands *and More*

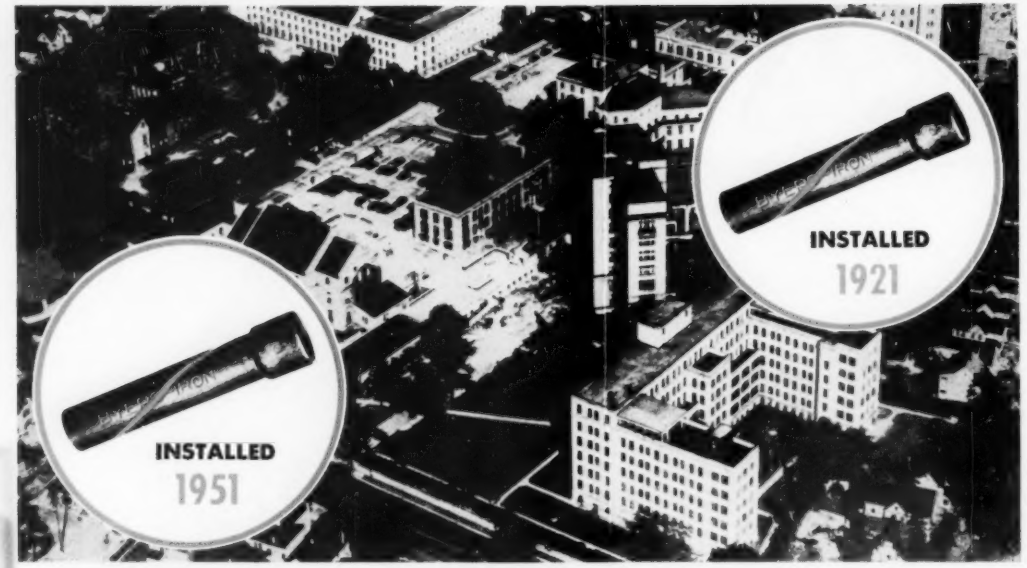
ORIGINATED BY EDWARD
"BIRTHPLACE OF BETTER
VALVE DESIGNS"

Another Product

**Edward Valves, Inc.**

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA




# IN CLEVELAND'S CITY HOSPITAL . . .

## 30 MAINTENANCE-FREE YEARS RECOMMENDED

# Byers Wrought Iron Pipe FOR RETURN LINES

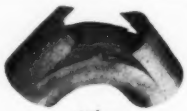
When engineers of the City Hospital, Cleveland, Ohio, made plans to replace the genuine wrought iron return lines in the hospital's boiler room, they had the best possible support for selecting the same material for the replacement piping. The old genuine wrought iron lines had served for 30 maintenance-free years.

There is no substitute for experience as a guide in selecting pipe for corrosive services. The City Hospital engineers, like engineers in every part of the country, have found that when corrosion is a threat to durability, genuine wrought iron can be counted on to combat the condition effectively, and serve longer at lower cost per year. In many reported cases, this time-tested material has doubled, tripled and even quadrupled the useful life previously obtained from low-first-cost piping, and ended maintenance headaches that had been regarded as incurable.

• • •

If you are concerned today with the construction, replacement, or repair of any boiler plant services, you will find some helpful information in our bulletin, WROUGHT IRON FOR PIPING SYSTEMS. We'll be happy to send you a copy on request.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.



### Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying material.

# BYERS

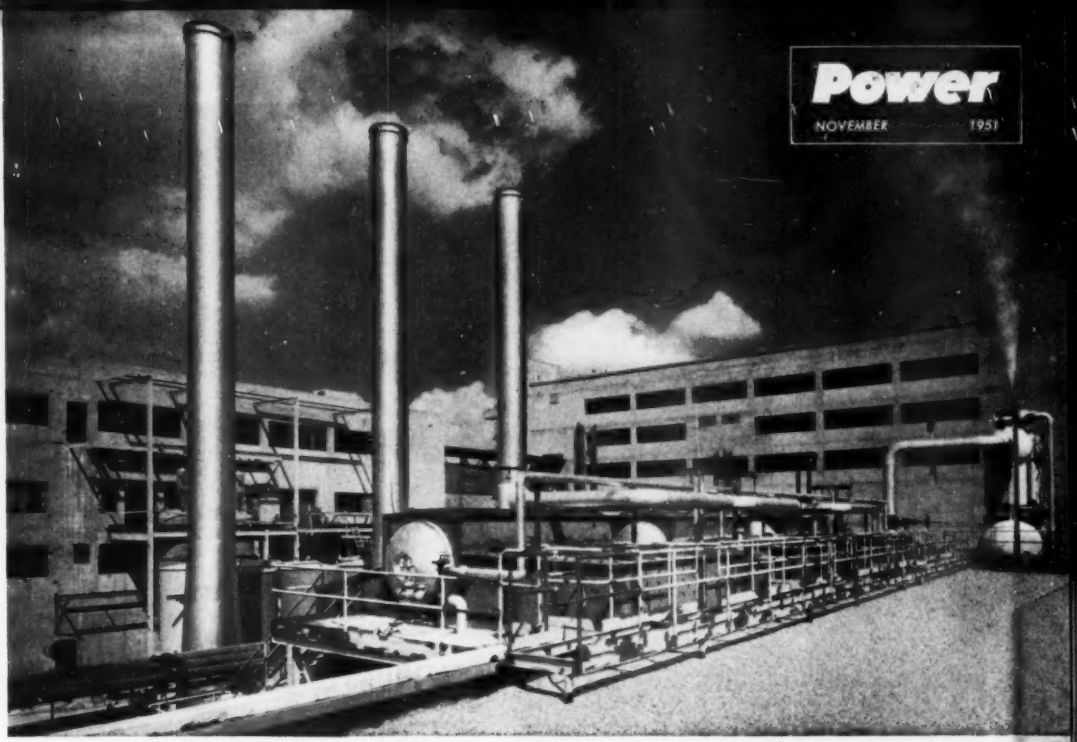
CORROSION COSTS YOU MORE THAN WROUGHT IRON

**WROUGHT IRON**

**TUBULAR AND HOT ROLLED PRODUCTS**

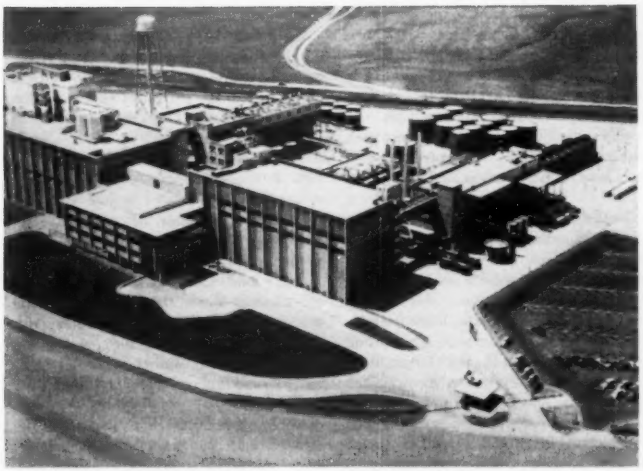
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
NOVEMBER 1951



**OUTDOOR BOILER CONSTRUCTION** is one of many steps taken for lower service costs in this . . .

# Design for Peak Power Versatility

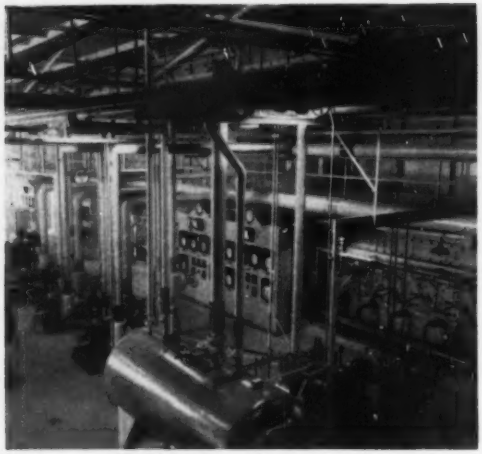


**PLANT INCORPORATES** latest ideas on flow of materials, every mechanical aid

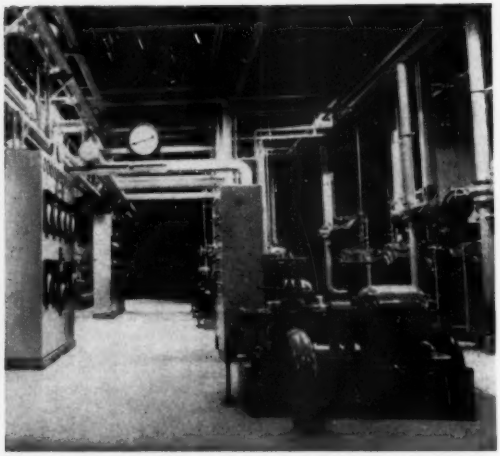
▶ Uninterrupted electric-energy supply comes from two separate utility company ties, flows through secondary network system

▶ Fuel flexibility has been built into the boiler plant so it can fire oil, gas, or both, to assure steam flow

▶ Refrigeration, air conditioning, compressed air meet special demands of certain processes in Lever Brothers' Los Angeles plant . . .



**GENERAL BOILER-ROOM VIEW** shows compact yet open arrangement of the major power-service equipment and controls



**CONTROL EQUIPMENT** has been put on panels set close to one another to give complete operating data in a convenient way

# LARGEST LOS ANGELES COUNTY INDUSTRIAL PLANT REQUIRES

► Lever Brothers Co's first Western plant, eight miles from downtown Los Angeles, features the latest advances in process-industry design. Major portions of refining and processing vessels and equipment, for example, are placed outdoors. In addition, the two chief jobs of soap and detergent manufacture, also of edible oils, go on in entirely separate building groups. Supplying them with all the power services and yet making provision against unwanted interruptions or breakdowns involved a number of design problems.

**1. ELECTRICAL LOAD.** Take the problem of continuous electrical power service, for instance. It was the most important because so many of the processes are continuous and any interruption means heavy dollar loss. The electrical-distribution system selected employs a primary radial feed to six unit substations with a secondary network coming off them. These substations have each a 1000-kva transformer. Altogether, they make up a 6000-kva system of top reliability, stepping down from a 4160-v primary to 460-v secondary.

Power for this system comes from a dual service connection with the Southern California Edison Co. This service is actually two separate sources, with one normally carrying the full load, and the other able to pick up the full load almost instantaneously through automatic throw-over in event of a failure on the normal supply.

The six substations are similar in construction and all parts are interchangeable. All transformers connect into the system in such a way that they contribute their share of capacity to the connected load no matter where that load is. Because the maximum electrical demand that can possibly occur is well below the full connected load (7800 hp of motors, 1900 kw of lighting, chiefly) the total transformer capacity, 6000 kva, was picked on the basis of demand rather than connected load. But forced air-cooling can be put in the transformers later and, in effect, increase transformer capacity from 1000 to 1250 kva. Besides, distribution-system design permits two additional unit substations of the same 1000-kva capacity to be added later.

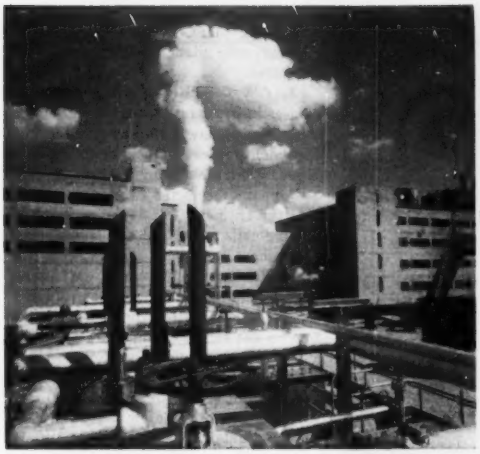
A study of plant equipment and operations indicated a 15-minute maximum demand of 4500 kva at a power factor between 85 and 90%. With the secondary network distribution system, top advantage can be taken of load diversity pf conditions. As a result, no special provision exists for heavy, intermittent loads, or emergency- or spare-equipment operation.

All these advantages entered into the decision-making stage when the design was finally picked. Actually, three possible methods came up for consideration: (1) secondary network system consisting of six unit substations with total capacity of 6000 kva, *method A* (2) primary selective radial system of seven units and total capacity of 7500 kva, *method B* (3) secondary selective radial system with seven double-ended units with a total capacity of 8000 kva, *method C*. In normal operation, *B* and *C* have units operating individually so they need a higher capacity than *A*, which takes advantage of the diversity in different power loads throughout the plant.

Installed cost estimates put *A* as the most expensive, *B* as the least. But because *A* could get by on only 6000 kva of transformer capacity and give the same reserve, its final costs appeared to be only 5% more than *B*. When all advantages and disadvantages were totaled up, *A*, the secondary network system, won out.

*A* has a number of operating advantages, well worth mentioning. First, electric power enters the plant at high voltage and feeds direct to metalclad switchgear. From there it goes to the unit substations placed close to individual load centers—definitely an advantage as far as continuity of service goes.

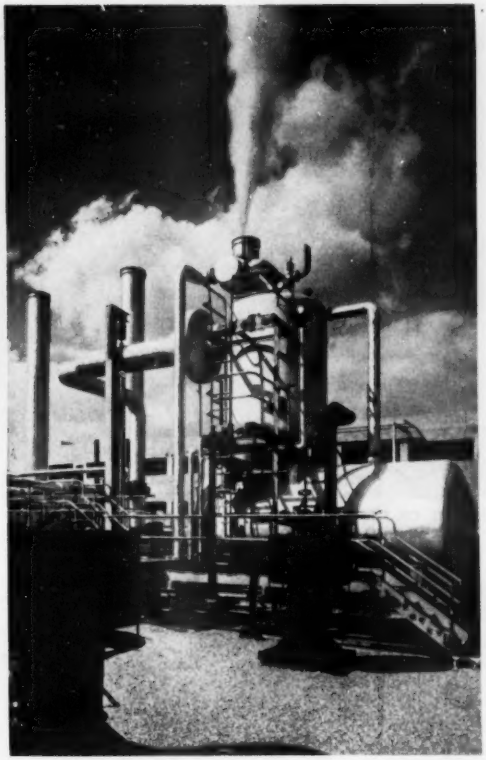
By breaking up the total plant load into a number of smaller load centers, the circuit-breaker equipment can be lighter and less expensive since they need smaller interrupting capacity (see Circuit Protection below). Secondary



**PIPING, VALVES, VENTS** of three boilers stand completely exposed at boiler roof level; allow easy maintenance, repair

## ALL POWER SERVICES:

- **A. 6000-kva electrical system, 7800-hp motors, and 1900-kw lighting**
- **B. 255,000 lb per hr, steaming capacity**
- **C. 450 tons refrigeration for air conditioning plus ammonia compressors for process freezing**
- **D. 9 cooling towers, other water-conservation aids**
- **E. 3 motor-driven 1000-cfm compressors for air**



**DEAERATING FEED HEATER** has been mounted on the boiler plant roof equipped with necessary catwalks for the operators

cable requirements are reduced because power comes in at high voltage right to the point of use. Voltage drop on secondary runs are less because they are shorter in length.

With several large synchronous motors and a relatively large lighting load on the secondary network, studies indicated a pf of about 85-90 at full load. This pf seemed high enough so that any later 5-10% correction of pf by corrective equipment would not particularly influence transformer or feeder size. Yet provisions have been made so capacitors can be added to the secondary circuit if ever pf does need correction.

**Circuit Protection.** Major objection to this secondary network system is the danger of extremely high short-circuit currents because all transformers are tied together. Unless special steps are taken to limit the short-circuit currents, extra-heavy circuit breakers and other related equipment capable of withstanding these currents have to go in.

Bechtel Corp, the plant engineering designers and constructors, selected high impedance transformers (10 against the usual 5%) to limit short circuit currents to less than 50,000 amp. At this figure standard equipment could be used. Ordinarily voltage regulation of a 10% impedance transformer is poor. But with all transformers on the line a 200-hp motor starting across the line produces a voltage variation of only 3%. A temperature relay on each transformer warns of high temperature.

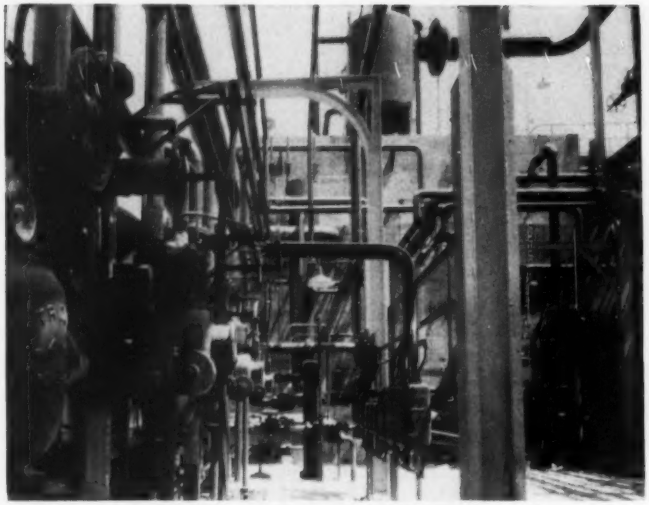
In addition to this short circuit protection the premanufactured and assembled unit substations, 20 ft long, 5 deep and 8 high, feature: (1) a primary manual load-break switch (2) a network protector (3) two sets of load limiters connecting the substation to the secondary network (4) a watthour meter for secondary distribution metering (5) a distribution section with a number of feeder circuit breakers. One substation has ground detector meters to warn of ground faults anywhere in the system.

The network protector isolates any troubles when a fault develops by disconnecting the high-voltage feeder, the transformer, or the circuit in the secondary network system, yet it does not interrupt main power service.

**2. BOILER PLANT.** Steam needs for a processing plant like Lever Brothers run high. And like the electrical energy it must be as continuous as good design can make it.

Every advantage was taken of mild Southern California weather to give as low cost an outdoor construction as possible. This aim included the boiler plant. Standing outdoors are the three 85,000-lb-per-hr 250-psi boilers, the feedwater-treating and -heating equipment, forced- and induced-draft fans and air preheaters. The fronts of the boilers form part of one of the boilerhouse walls as shown in photos, facing page.

These boilers are each fired by four combination gas and oil steam-atomized burners and have individual self-supporting steel stacks. Natural gas is the primary fuel but a complete oil-storage,



**EXTENT OF THE ROLE** played by the power services shows in complicated piping, valves, controls supplying a typical outdoor process hookup, such as shown above

**SOAP KETTLE,** above, 180,000-lb capacity, boils its materials for a solid week with the heating steam flow uninterrupted, so assured steam supply is essential

heating, pumping and firing system is ready for use.

Controls of the latest type and design have been placed in powerhouse equipment. Each boiler has an individual combustion control and meter panel that permits easy, centralized operation. Individual boilers or the entire plant can be run manually or automatically, depending on the position of the different selector valves.

A smoke-density indicator-recorder ties in with the alarm system to warn of any smoke formation. Another special warning arrangement is a separate annunciator panel. This has an audible alarm and 48-point warning lights connecting to the various operating equipment and lines to both warn of failures and locate trouble sources.

The two Dowtherm vaporizers for process heating draw their required heat, up to 2,000,000 Btu per hr, from steam connections in the boiler plant. In addition all water-treatment equipment, boiler feed pumps and auxiliaries are housed in the boiler plant.

**Compressed Air.** Three synchronous, motor-driven, 1000-cfm compressors equipped with automatic 5-step clearance pockets handle compressed-air supply for the whole plant.

Pumps for process-water needs and fire protection, which tie into the city-water system, are in the boiler section of the power plant. Electrical switchgear for the main plant feeders are also in this area.

**3. AIR CONDITIONING.** Certain phases in the manufacture of edible and detergent products require year-around air conditioning. Other areas need a constant supply of tempered filtered air.

Both the steam for heating hot water and the chilled water for the air-conditioning coils come from the boilerhouse. Equipment that cools the water is discussed later under Refrigeration. Chilled water is pumped at a constant rate and its temperature varied by a control system on the refrigerating compressor.

Central air conditioning for the office building involves a system using a tempering coil in the outside air path, a varying percentage of mix between return and outside air, followed by an air washer. The washer cools the air before it enters the various zones. Secondary coils in each zone provide finite temperature regulation.

Sixty percent of the 50,000 cfm of circulated conditioned air is continuously exhausted from laboratories and kitchens where it can become somewhat contaminated.

A novel feature of the system is its method of reheating air. An air-piston motor links mechanically to a rheostat and the rheostat's movement varies a dc voltage to a saturable reactor. When this happens the excitation current in the reactor changes and so does the ac voltage to the reheat coil. The result is a stepless control from 5-100%, in contrast to the usual ON-OFF arrangement for zone-temperature adjustment.

**Refrigeration.** Back of the air conditioning for comfort and process are two 225-ton Freon turbo-compressors, one steam driven and one motor driven, in the refrigeration room of the power plant. These compressors supply the chilled water at about 40 F. Two separate motor-driven ammonia compressors handle the direct refrigeration load for the edible oils' manufacturing area.

Water and its conservation are subjects of prime interest in the Los Angeles County area. Neither time nor money was spared to put in all possible controls on water use and also equipment to conserve it. The largest single example is a battery of nine cooling towers with their cells erected together to save space and give a better appearance. In addition, special oil separators on the cooling-water return system from the emulsified oils and fats process sections fit this water for reuse.

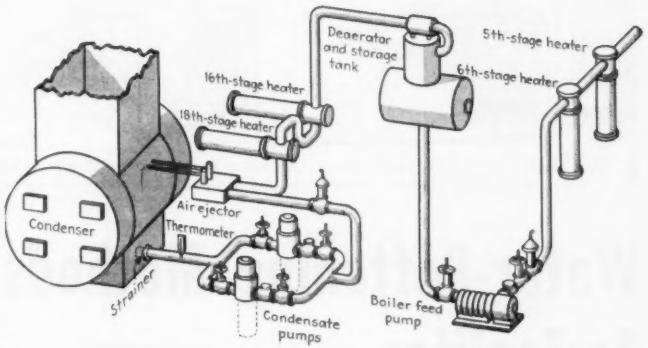
All the above details contribute to making this the most modern soap and detergent plant in the world.

# Rx Could You Cure This Headache?

▶ **One man's miserliness may cause another's misery . . .**

▶ **Couple this with tendency to make casual instead of thorough inspections and you have real trouble . . .**

▶ **Don Swift, Ebasco Services Inc., adds to his series. . . .**




**STATION WATER SYSTEMS** are pretty complicated no matter how you look at 'em. They seem more so when they act up and you have to take 'em apart piece by piece

## Case No. 6—

# THE CONSTIPATED CONDENSATE SYSTEM

▶ WHILE WE WERE PUTTING the finishing touches on a new 60,000-kw unit, city water became scarce temporarily. So we had to conserve water when we were ready to test and flush out condensate and feedwater system, and boil out the boiler. We first tested the condenser for leaks, then used this water to flush out piping, heaters and valves and as feedwater for boil-out. Everything was drained, inspected, and found clear, including a drainer screen on the condenser hotwell outlet. This screen, which was within the hotwell, prevented foreign material entering the condensate pumps.

Next, we got ready to blow out the main steam line and test safety valves by filling the new condenser with condensate from the existing station unit. This water was then pumped to the boiler through the feedwater system by one of the condensate pumps (the other had a broken coupling). During the several days needed for the work the condensate pump pressure decreased slightly. Capacity was also dropping so that finally we could get just enough water to the boiler for valve setting.

**Trouble.** Current drawn by the pump motor was also below normal. Since no flowmeters were working then, we checked the pressure at several points in the system. These showed abnormally high-pressure drops through all heaters, especially when considering the low flow. Low motor current checked against suspected low flow, but the low discharge pressure indicated high output.

First, we checked pump rotation and found that OK. Next, following through the system we opened the steam-jet air-pump condenser. Its inlet tube sheet was solidly matted with manila rope fibers. Strands projected into the tubes some 4 to 6 inches. Then we opened the horizontal low-pressure heaters and found their inlet tube sheets matted almost as heavily. These were all cleaned up by blowing out with air.

The deaerator's vent condenser was also badly clogged, so we decided to inspect the deaerator trays and other internals. We had to remove all trays to do a proper cleaning job, but found fewer fibers as we got to the bottom. At the bottom of the deaerator storage tank we found a ½-in.-thick layer of matted mud and fibers.

The boiler-feed-pump suction strainer was nearly plugged with matted fibers. Fortunately cold feedwater and low flow prevented trouble in the pump. The first high-pressure heater had a handful of fibers and the last heater very few. We inspected the boiler drums but found none. As a precaution we gave these drums a heavy blowdown to clear out any possible accumulations and drained the economizer, but found no fibers.

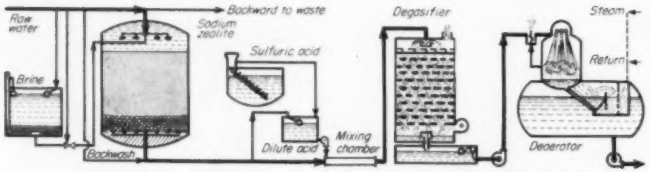
All the check and regulating valves in the low-pressure condensate system had gathered their share of shredded rope. Five days to clean up this mess!!

**The Culprit?** As soon as we found rope particles we also opened up the condensate pump. In the pump suction was wedged a tightly rolled bundle of ¾-in. manila rope, about 20 ft long. It was tightly wedged in the impeller vanes, wearing ring clearances and pump bearing clearances. The entire pump had to be dismantled for cleaning, but we luckily found no mechanical damage. To play safe we also opened the feed pump used during this period, but there were no signs of rope in it.

Neither was there any trace of rope in the condenser hotwell. But we found the thermometer well in the hotwell discharge line bent downstream at a 30-deg angle. We surmise the rope hung onto this well for a time before entering the pump. The pipe men swear there was no rope in this pipe when they installed it. Inspectors backed them up.

We think someone wanted to cache 50 ft of new rope. So he coiled it into a tight bundle and laid it inside the recess formed by the hotwell outlet screen. Later the pipe men welded on the 16-in. pipe without seeing the rope coil. When the condenser was filled and the condensate pump started, the coil moved down the pipe, hanging onto the thermometer well for several days. It finally entered the pump suction. The impeller gradually tore it to bits.

"Give a man enough rope and he'll hang himself," they say. It looks like he could hang a whole power plant too!




**1** Flow diagram shows raw water's course through a sodium-zeolite softener (with a brine-regenerating system) followed by acid treatment, aeration, deaeration

# Water-Softening Methods 1: Zeolites

By PAUL BRINDISI, *Calco Laboratories*

**Initial low-cost or first-glance advantages of a water softening method often blow up in your face when you put the system in your own plant. Here's the start of a series that pins down basic considerations in judging softening methods**

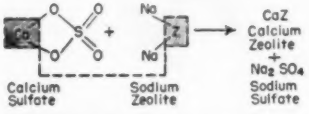
► THE ATTRIBUTES and initial low cost of a specific external water-softening system by themselves should never be the basis for selection. Instead, that system and all other possible ones should be studied on the grounds of adaptability and limitations for your particular plant. When all facts are in, then and only then, make your choice. Too often if troublesome and expensive adjustments are required later, they wipe out all savings on the lowest-cost installation and leave you with a makeshift system.

What are the principal considerations? First off, chemical composition of raw water alone does not determine a method's suitability. Of far greater importance, particularly with higher than normal pressures, are the chemical concentrations the boiler water may develop under operation. It is true, however, that effecting a simple, economical removal of the raw water's total hardness is a prime concern. Yet the overall purpose of an external conditioning system is not merely for softening but rather to furnish a feedwater that can protect the steam generator and its after-system from all possible water-emanating troubles.

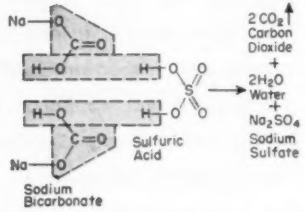
In selecting an external treating system, take every advantage of natural chemical characteristics of the makeup water. With increased operating pressures and their demand for lower total solids concentration in boiler water, it becomes all the more necessary to shift the burden of chemical conditioning external to the boiler. While internal correction is always a needy follow-up measure, it must be sharply curtailed in the face of higher rates of heat transfer.

Let's look, then, at the basic external water-treatment systems. They can be classified as members of the sodium-zeolite family, the lime-soda group, or combinations of both. What are the merits of each and their limitations?

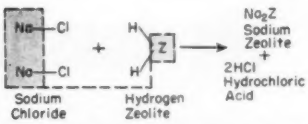
**1. SODIUM ZEOLITE.** In the common sodium-zeolite procedure the sodium of the softening medium replaces the calcium and magnesium that make up the total hardness of the raw water. The softener bed thus changes to calcium and magnesium zeolite, while the sodium forms of the salts, naturally present in the raw water, leave with the treated water, Fig. 2. The bed is regenerated with sodium chloride (common salt) to displace from the zeolite the calcium and magnesium it has acquired and thereby replenish the sodium ions needed to carry on further exchange reactions with the raw water, Fig. 3. In this way the total hardness of most waters can be reduced to a very few ppm.



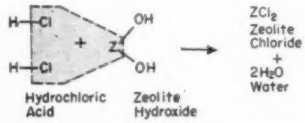

**2** Zeolite-sodium ions replace the calcium hardness element in water




**4** Objectionable bicarbonate alkalinity decomposes under the action of acid




**6** Hydrogen zeolite replaces the calcium-magnesium hardness, sodium

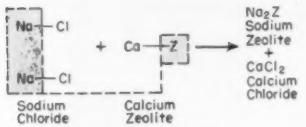



**8** Cation exchange, *6*, followed by anion bed, *above*, gives demineralization

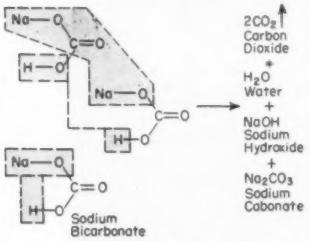
**Zeolite Limitations.** Hardness of a water gets more difficult to remove as its sodium content assumes a relatively higher proportion. Then the sodium mass causes a reverse reaction with the zeolite. Some of the calcium and magnesium already absorbed by the bed are freed and as a result the water emerges only partially soft. This holds true for briny well and river-mouth waters, which suffer seasonal sea-water contamination.

Contrary to common belief, an absolute zero hardness is unobtainable with the zeolites. Yet the standard soap test is generally accepted as indicating that happens. Some hardness continually passes through the softener. This may be minute for a low-hardness water or considerable for a high-sodium water. Hardness that escapes removal, plus

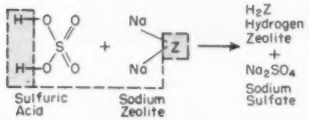
## . . . AND THE REACTIONS



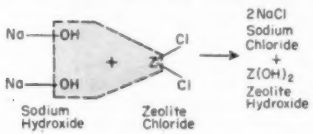

**3** Regenerating brine supplies sodium to displace calcium, *picked up in 2*




**5** Untreated bicarbonate in feedwater breaks down in boiler, gives off $CO_2$




**7** Sulfuric acid instead of brine regenerates the hydrogen-zeolite bed




**9** Water, *from 6 and 8*, gives the hydrogen, hydroxyl ions for more water

### TYPICAL RESULTS ON WATER UNDER ZEOLITE TREATMENT

| | *Raw water* | *Zeolite effluent* | *Acid-treated water* | *Degasifier effluent* | *Feed water* |
|---|---|---|---|---|---|
| Total hardness as $CaCO_3$ | 122 | 2 | 2 | 2 | 1 |
| Ca hardness as $CaCO_3$ | 98 | 2 | 2 | 2 | 1 |
| Mg hardness as $CaCO_3$ | 24 | 0 | 0 | 0 | 0 |
| P alkalinity as $CaCO_3$ | 0 | 0 | 0 | 0 | 0 |
| M alkalinity as $CaCO_3$ | 104 | 104 | 40 | 40 | 26 |
| Sulfates as $SO_4$ | 42 | 42 | 100 | 100 | 50 |
| Chlorides as Cl | 34 | 34 | 34 | 34 | 17 |
| Sodium as Na | 33 | 91 | 91 | 91 | 48 |
| Silica as $SiO_2$ | 2 | 2 | 2 | 2 | 1 |
| $CO_2$ as $CO_2$ | 23 | 23 | 51 | 2 | 0.5 |
| Total dissolved solids | 306 | 320 | 328 | 279 | 142 |
| pH value | 7.1 | 7.1 | 6.2 | 8.1 | 7.3 |

that which rapidly mounts with exhaustion of the softener's exchange capacity and that portion bypassed during regeneration, comprises the total hardness undergoing concentration in the boiler water.

This unaffected hardness can be kept to a minimum with efficient operation of the softener by testing effluent at frequent intervals and regenerating the bed immediately when effluent hardness rises. Over and above the hardness otherwise permitted to pass through, prolonged and repeated overrunning of the bed with hard water may lead eventually to fixing a portion of the zeolite and subsequently decreasing its available exchange capacity.

While the zeolite softener closely resembles a sand filter, never use it to clarify a turbid water. Any sediment removed coats the zeolite granules and isolates them from further contact with the water, reducing the efficiency of the softener. Only naturally clear or prefiltered waters, like city and most well supplies, should use zeolite systems. Surface waters invariably require coagulation and filtration before the softener, thereby increasing costs to the disadvantage of a proposed zeolite use.

Soluble iron and manganese of unexposed well waters submit to the same exchange reactions with sodium zeolite as do calcium and magnesium. But if they come in contact with air, these elements are oxidized and precipitate out of solution in the form of nonreactive particles, which foul the bed's surface to where it has to be replaced frequently.

Strongly acidic or alkaline waters are most detrimental to ordinary sodium zeolite, whether it's common greensand, synthetic or carbonaceous. The raw water's pH value should be consistently carried around the neutral point (7.0) and not permitted beyond the safe extremes of 6.5 and 8.2. Further, the water's temperature should never be allowed to get above 150 F, or the zeolite will suffer slow disintegration. What's more, with a siliceous bed objectionable additional silica gets into the feedwater under too high a temperature.

Recently special preparations of sodium zeolite have been marketed, capable of withstanding these otherwise adverse conditions.

The pH problem occurs more often than too high a temperature. With pH, the question resolves into whether the higher initial expense of this new resinous zeolite method can be justified against the cost of adjusting the water's pH value with either an alkali or acid, and then softening by one of the normal sodium-zeolite forms.

A sodium-zeolite effluent is quite corrosive. In having virtually all the calcium removed, raw water is deprived of its natural tendency to deposit a protective calcium carbonate film on the metal surfaces. This film ordinarily resists attacks by the dissolved oxygen and carbon dioxide gases of the water. The intermediate piping and equipment between the softener and feedwater heater suffer most from corrosive action and may need frequent repairs. So when storing softened water, apply one of the several proven plastic or tar-base protective paints to the interior of either the steel tank or the concrete storage basin. These coatings protect the tank from being badly corroded and prevent contaminating the feedwater with harmful rust particles. A concrete basin needs this coating for quite another reason. It forestalls absorption by the softener effluent of appreciable amounts of undesirable calcium and magnesium silicates as well as iron and aluminum oxides. The effluent, under-saturated with respect to hardness, exerts a strong erosive action upon concrete.

By softening the makeup water with sodium zeolite you'd think a decided reduction in blowdown would be in order and you'd realize a saving in cost of both fuel and water. But this seldom is permissible. Instead, an increased rate of blowdown is generally necessary.

Why? Since the softening procedure merely involves replacing sodium ions

(*Continued on page 210*)

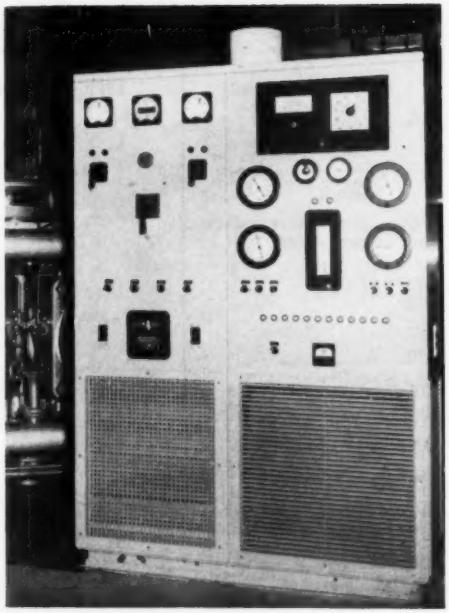
## *Diesel Instruments and Controls: 10*

By EDGAR J KATES, *Consulting Engineer, New York, N. Y.*

# Alarm Circuits: How They Operate

**A good alarm system should start and check itself, locate faulty conditions, and shut off signal while trouble is corrected.**

**Here's a practical guide to ways of getting as many of these features as your own plant conditions require**



**CONTROL AND ALARM PANEL** in large plant has a row of lamps, *lower right*, which indicate the faulty condition

► ENERGIZING AND CONTROL of an alarm system aren't as simple as might first appear. Some of the requirements to consider are:

**1. Energizing.** If an alarm system is to safeguard an engine all the time it runs, the alarm circuit must be energized as soon as the engine starts. Also, the system, or part of it, must be de-energized when the engine stops, to avoid continuous sounding of the low-lube-oil-pressure alarm and to prevent power waste and unnecessary lighting of electric lamps.

Where engines drive generators, energizing and de-energizing of each unit's alarm circuit is accomplished quite simply by connecting it directly to the generator terminals. Thus the alarm system is activated as soon as the generator builds up voltage, even before the main generator switch is closed. Where high-voltage generators are installed, power the alarm system from the plant auxiliary bus or the station battery, using a relay connected to generator or exciter terminals to cut the circuit in or out.

A *throttle switch* is often used to cut alarm systems in or out. This is simply a switch mechanically connected to the engine control lever in such a way that switch is closed whenever lever is in "running" position.

**2. Indication of Readiness.** A good alarm system gives proof throughout the time the engine is running that it is energized and in working order. The fact that the system is energized can easily be indicated by a pilot light, but to show that a complete circuit exists to each fault-switch usually requires a closed-circuit system using double-throw fault switches.

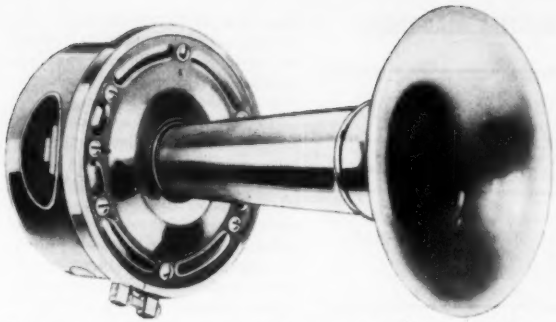
**3. Fault Location.** Common practice calls for using a single warning system to alert the operator that conditions aren't as they should be. But giving the alarm is only the first step. It's almost as important that the operator, after hearing the alarm signal, be able to find quickly the faulty engine and spot the cause.

One way to indicate the particular fault is to use an annunciator. This carries a bank of "drops" or flags, one for each fault-switch. When a fault-switch operates, its flag goes down and remains down until reset by hand. Thus it can identify the condition causing the alarm even after the trouble has been cleared.

A commoner form of fault locator consists of a bank of small electric lamps, one for each condition being protected (see photo above). It may be so arranged that all lamps are normally out, with one light coming on to indicate a given faulty condition. In a better arrangement, all lamps remain on when conditions are normal; one goes out when a particular fault develops. Thus, when conditions are normal, operator can see that alarm system is working.

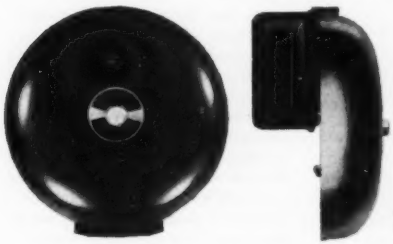
Where only one or two engines are concerned, trouble lights on individual alarm panels suffice to show just which condition is faulty. This is by no means true, however, if the engine room is large or if there are many engines. For such cases the fault-finding procedure may be expedited by having one or more large illuminated numeral panels in well-exposed locations. These will identify the engine in trouble and the operator can go directly to that unit and tell from its individual panel which condition is at fault.

**4. Shutting Off Signal.** After alarm has sounded and operator has located the fault, he will naturally want to shut off the signal while he is at work correcting the difficulty. The signal is annoying but, even



**1** Horn or howler works by rapid vibration of a diaphragm to produce distinctive tone and pitch which cuts through plant noise

**2** Motor-driven high-speed fan in ported housing makes powerful and unusual siren sound



**3** Contactless vibrating bell or gong has only one moving part, a solenoid plunger. This 10-in.-diameter unit takes only 11 watts

# WARNING SIGNALS MAY BE GIVEN BY HORN, SIREN OR GONG

Warning signals may be either visual or audible. If visual, they are generally electric lamps that light (or go out, in some cases) when alarm point is reached. Usually, alarm signal is given by sound, and lamps are used merely to show which function is abnormal.

Audible signals may be given by horn, siren or gong. A horn or howler, Fig. 1, works by rapid vibration of a diaphragm. It produces a distinctive tone and pitch, which cuts through engine-room noise. In ac howlers there are no contacts: vibrations follow ac cycles, and pitch is double that of current frequency. They use little power; a 7½-in.-diameter howler takes about 20 watts. Howlers can be had with horns pointing two ways.

Sirens, Fig. 2, have a motor-driven fan turning at high speed within a ported housing. This produces a powerful signal of unusual tone, which can penetrate other noise. An 11-in. siren uses about 150 watts.

Continuous-sounding bells or gongs may contain interrupting contacts (always if dc). Fig. 3 shows a contactless vibrating bell, which has only one moving part, a solenoid plunger. It operates on 110 volts, 60 cycles; 10-in.-diameter size draws only 1/10 amp.

---

more important, the continuing signal prevents a subsequent fault elsewhere from making itself known to the operator.

A simple disconnect switch can be used to shut off the alarm. But this makes the alarm system inoperative not only temporarily while the first fault is being corrected, but also possibly for a long time after if the operator forgets to reclose the switch when his work is done. A good way to take care of this calls for using an alarm disconnect switch having a time-delay device to reconnect it after a certain interval. Another scheme is to arrange circuit so only the audible signal can be shut off and visual signal continues.

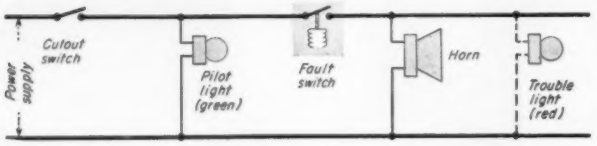
**5. Need for Relays.** Relays are used in alarm systems not only to energize them automatically, as previously stated, but also to avoid overloading the fault-switches in large systems using powerful sirens, large lamps, or a considerable number of signals. Relays are also needed when the signals are supplied from a different source of power than that which flows through the fault-switches.

**Simple Open Circuit.** Fig. 4 (next page) shows an elementary open-circuit alarm system, used when costs must be kept to a minimum. In extreme cases, even the pilot light may be omitted. A trouble light (red) may be used in addition to the horn.

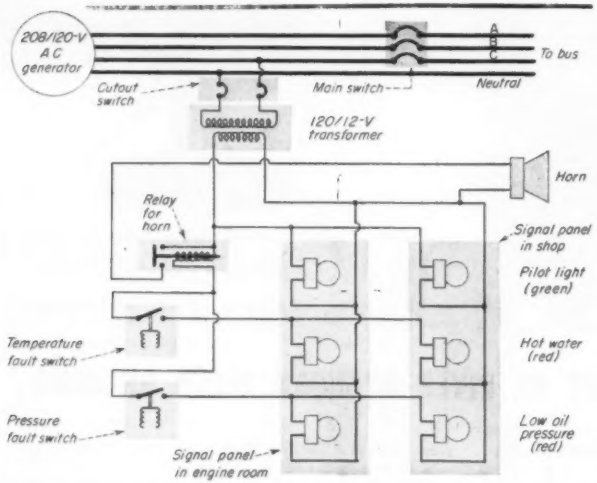
Note that the pilot light (green) indicates only that the cutout switch has been closed and that current has reached the pilot light. It does *not* reveal whether the wiring to the fault-switch and horn is in working condition, nor are any means provided to test this. As shown, the cutout switch must be closed manually when the engine is started. Substituting a throttle switch will light the pilot lamp automatically.

If a combination temperature-and-

## TYPICAL OPEN-CIRCUIT ALARM-SYSTEM DIAGRAMS




**4** Elementary open-circuit alarm system may be used when cost must be kept down. Pilot light may be omitted; a trouble light may be added as shown




**5** More refined open-circuit system has two signal panels with trouble lamps on both. It is automatically energized as the generator builds up voltage

pressure fault-switch is used (POWER, Oct 1951, p 82), either high water temperature or low oil pressure will close the same pair of contacts. Consequently, the alarm signal does not indicate which condition is at fault.

**Improved Open Circuit.** System of Fig. 5, designed for 12-v alarm devices and single-throw fault-switches, is more refined. Among its features are: (1) Two signal panels—a safeguard if engine operator is not always in engine room. (2) Trouble lights on both panels show which condition is at fault. (3) Transformer energized directly from generator terminals puts alarm system into service automatically as soon as generator builds up voltage, even before main switch is closed. Cutout switch is kept closed even when engine is stopped. (4) Relay carrying horn current prevents overloading of fault-switch contacts.

**Flasher Unit.** Fig. 6 shows an ingenious, simple, self-monitoring closed-circuit system. It uses single-throw 12-v fault-switches, whose contacts are closed when operating conditions are normal. Feature of this patented system is a flasher unit, which causes its connected signal light to shine dimly when conditions are normal and to flash repeatedly from dim to bright when something goes out of whack. Thus a single lamp serves both as a pilot and as a trouble light. Another feature is the 15-20-second time delay introduced by the bimetallic flasher switch; this prevents incorrect signals due to transient conditions.

Flasher unit contains two bimetallic blades, each surrounded by a "heater" winding. The "control" winding (right blade) forms a circuit with a normally closed fault-switch It is thus ordinarily hot, causing its bimetallic blade to bend right. (In drawing, blades appear in "power off" position.) The "flasher" winding on the left blade forms a closed circuit with the signal lamp.

**How It Works.** When conditions are normal, current flowing through each winding bends both blades right, leaving contacts open. Any interruption of the control circuit, caused by a fault-switch operating or by a connection breaking, allows the right blade to cool and make contact with the left. This passes full voltage through the signal lamp, which then flashes bright. But the closing of the contacts shorts out the left winding, the bimetal cools and contacts separate. Light then becomes dim but flashes bright again as soon as the bimetal heats.

If minimum cost is imperative, the system can be further simplified by using only a single flasher unit and signal lamp, with the control circuit containing any number of fault-switches (normally closed) in series. This, of course, gives no indication as to which condition is at fault.

Lack of alarm horns or sirens would put this system at a disadvantage in plants where more than visual indication is required by operating conditions.

**Basic Closed Circuit.** The closed-circuit system of Fig. 7 uses fault-switches of the double-throw type. It meets many of the requirements of a good hookup and further refinements may be applied readily. The system is automatically energized all the while the engine runs and it gives continuous evidence that all parts of the system are in working order.

Signal panel carries a pilot light and also an indicator lamp for each condition under protection. When engine starts, automatic throttle switch energizes the circuit and all lights come on. Note that the pilot lamp is in series with the warning horn. The lamp will go out if the circuit through the horn accidentally breaks. On the other hand, the horn does not sound because of the relatively high resistance of the pilot lamp.

**System in Operation.** When all conditions are normal, fault-switches are in the "monitor" position and current passes to their respective indicator lamps. Thus when all lights are shining, circuits through horn and fault-switches are complete, and protected temperatures and pressures are normal.

If one of operating conditions becomes abnormal, its fault-switch throws to the "alarm" position. This

puts full voltage on the horn and gives the warning. At the same time the indicator lamp for the affected condition goes out, thus identifying the source of trouble.

Test switch puts full voltage on the horn by shorting the pilot light. It merely tests horn operation.

**Refined Closed Circuit.** Closed-circuit system of Fig. 8 (based on circuit used by Viking Instruments, Inc) is refined to meet additional requirements. Indicator lights are normally out, but the system is completely monitored. Furthermore, after an alarm has sounded, the horn signal can be stopped temporarily while the red indicator lamp remains lighted until the trouble is corrected.

Coil of monitoring relay is energized normally through the monitor contact of the fault-switch to which it is connected. If a connecting wire should break, relay's contacts will close, permitting current to flow through the corresponding indicator lamp, in series with the pilot light. Thus the red lamp will light with reduced brilliance. The horn circuit is monitored by the pilot light, with which it is in series. Thus the illuminated pilot light shows that power is turned on and wiring to horn is complete.

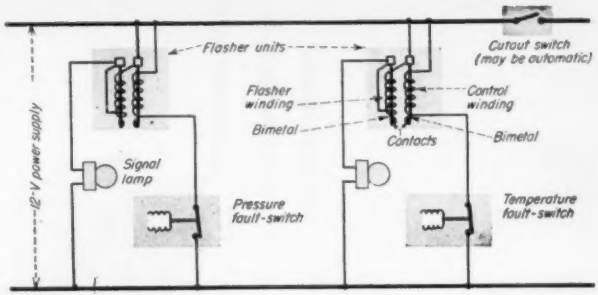
**Fault Indication.** If an engine operating condition becomes abnormal, the fault-switch will throw from the monitor position (*M*) to the alarm position (*A*) and monitoring relay will close, putting full power on both the red indicator lamp and on the horn. The pilot light goes out.

While the operator is correcting a fault on which alarm has been given, he can avoid the nuisance of a continuous horn signal by pressing the push-button energizing the horn-silencing relay. This opens the relay's lower contact, which silences the horn. It also closes the upper or holding contact of the relay, thus keeping it energized until the operator resets it.

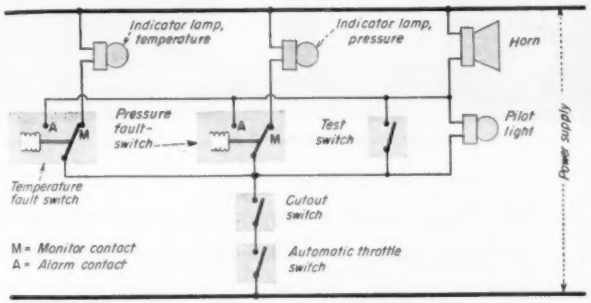
Meanwhile the red indicator lamp remains lighted until the fault-switch returns to its normal monitor position. Also, a fault occurring elsewhere during this period will make itself known by both blowing the horn and lighting its own indicator lamp.

The test pushbuttons do more than blow the horn, as in the previous diagram. Here they simulate the action of the corresponding fault-switch by opening the monitor contact and closing the alarm contact, thus checking the functioning of all the related parts and wiring.

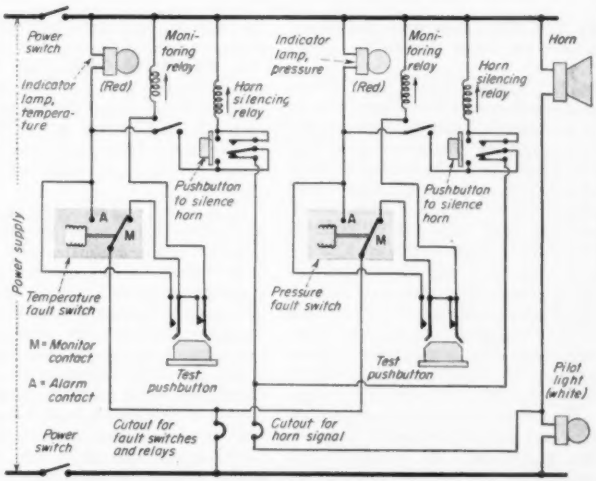
## TYPICAL CLOSED-CIRCUIT ALARM-SYSTEM DIAGRAMS



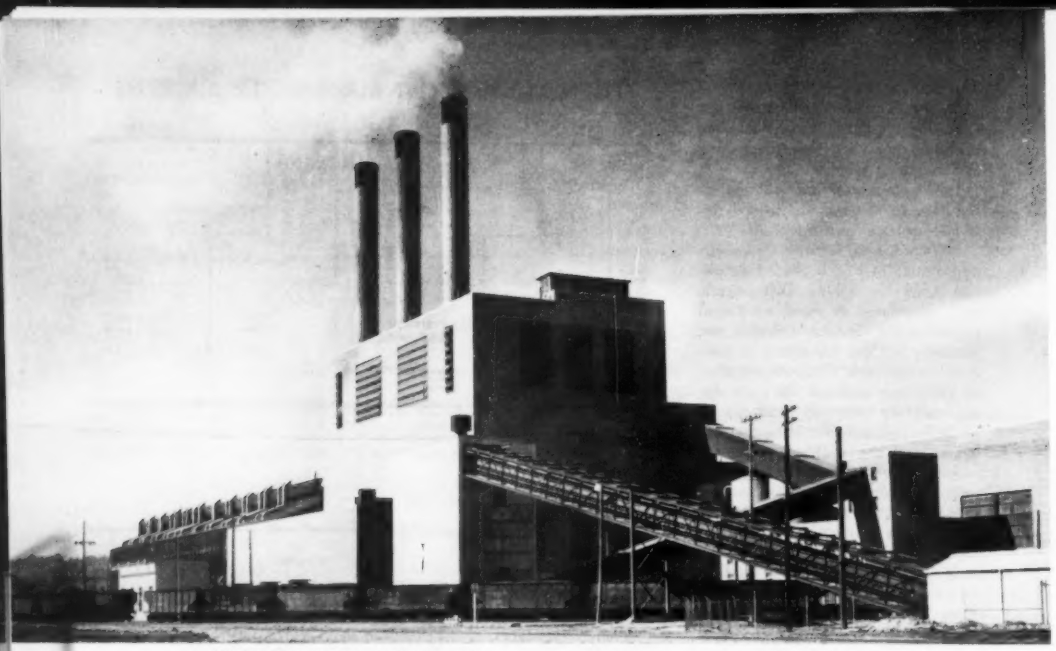

**6** Simple, self-monitoring closed-circuit system uses flasher unit; single lamp serves both as pilot and trouble light. Designed for 12-v operation




**7** Basic closed-circuit system uses double-throw fault-switches, meets many of the requirements for a good hookup. Refinements may be added readily




**8** Refined to meet additional requirements, this closed-circuit system is completely monitored. Horn signal may be stopped while a fault is cured



**WAR-BORN POWER PLANT** at Oak Ridge, Tenn., has hung up an enviable reliability record

**Oak Ridge atomic energy plant's been burning coal, oil, gas, or mixtures of the three, right along, depending on price, availability. And here's . . .**

# . . . How Coal, Oil and Gas Compare

By **D H RILEY**, *Supt, Power Operations Carbide and Carbon Chemical Co*

► THE OAK RIDGE power plant for wartime atomic-energy development went up in ten months. Steam-generating equipment going into that plant—three boilers, 750,000 lb per hr, 1325 psig, 935-F superheater outlet temperature — were designed for a pulverized Tennessee bituminous coal, Table I, p 92, available in this area. These boilers are a single-pass type, with fully watercooled furnaces, economizers, tubular air preheaters. The main boiler's tube bank consists of four staggered rows of 3-in. tubes, spaced on 18-in. centers with 24 tubes per row. The superheater employs three banks of tubes, each with 97 elements.

Because of the great interest in slagging and slagging-causes the composition of the metal in the superheater section is of vital interest in any discussion of fuel-burning experiences. Metal composition varies in the different superheater banks. Top and intermediate banks have low carbon steel tubing; the bottom, carbon-molybdenum and chrome-molybdenum-titanium tubing.

**1. PULVERIZED COAL.** From April 1944 to January 1950, we burned mostly pulverized coal, except during the 1946 coal-strike period, when we switched to oil, *see below*. In the main we enjoyed success in firing a range of coals, Table I.

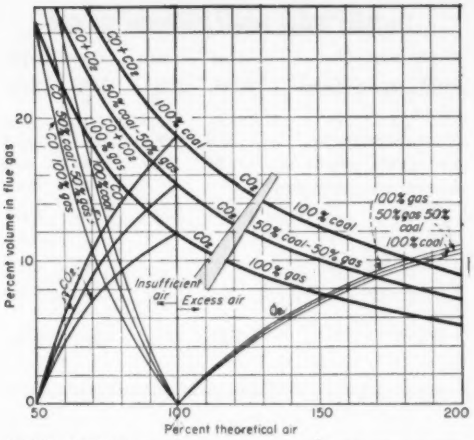
Slagging and slag accumulation never reached the point where soot blowers could not remove it satisfactorily. Part of the reason, we feel, results from an operating procedure we follow, based on tests and previous experience. In short, we believe that once the average true gas temperature leaving the furnace climbs above the oxidizing deformation temperature of the ash, we can look for trouble in cleaning ash from convection surfaces. If operation continues at this point for any appreciable time, hand lancing becomes a necessity.

To avoid this problem we stress the importance of providing enough air at the burners, minimizing air leakage and otherwise taking all steps to insure efficient combustion under oxidizing conditions. The furnace atmosphere plays an important role in affecting the fusion characteristics of coal.

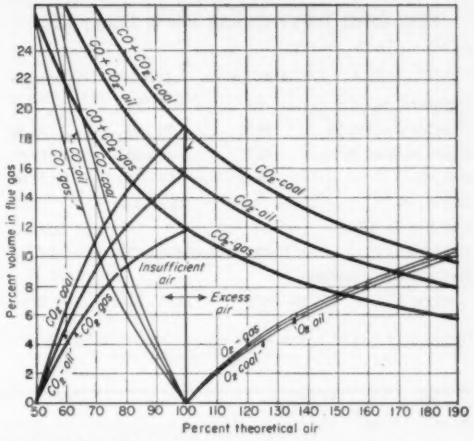
**Tube Wastage.** After a few years' operation we noted that front and rear waterwall tubes were gradually wasting over an area from about 4 ft above the furnace floor at the center, arcing down to the corners at each side. Outer layer of slag ran about ¼ in. thick, was hard, brittle, with a rough, porous appearance, and generally grayish brown in color. Beneath this layer lay a thin slag deposit that adhered more tightly. Its color varied from white to greenish-blue in some areas, but grayish-black was the predominant color. We sandblasted the area, and welded horizontal fins to the tubes on ¾-in. centers, then covered them with chrome ore. It gives good surface protection and needs little attention.

But what caused this tube wastage? Tests showed CO in the range from 0.1 to 3.7% along front and rear furnace walls in this area. Part of the answer

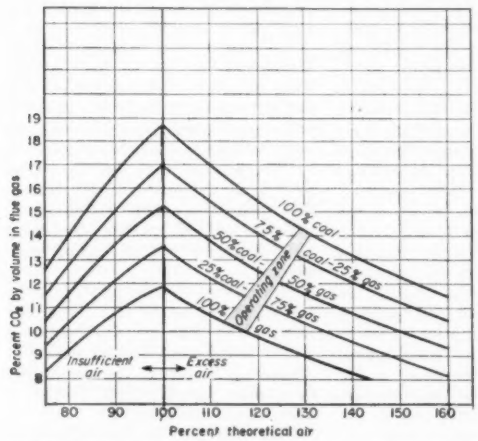
## FIRING DIFFERENT FUELS CHANGES RELATIVE PERCENTS OF COMBUSTION PRODUCTS



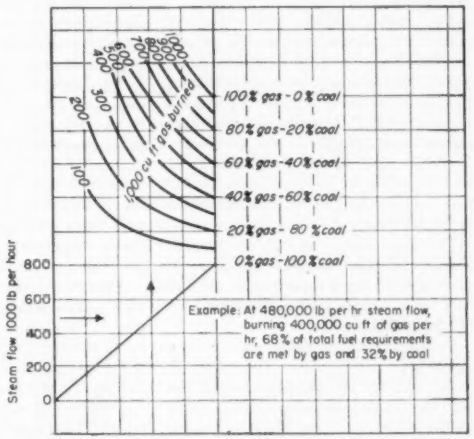

**HERE'S ACTUAL** flue-gas combustion products with percents of air for firing the mixtures of coal and gas on Btu basis




**THEORETICAL PRODUCTS** of combustion resulting from firing coal, oil or gas with varying amounts of air supplied, above




**HERE'S HOW** the operating zone fits in to affect limits of the air supply actually used and the $CO_2$ that they produce


Steam flow 1000 lb per hour
1200 cu ft gas burned
100% gas - 0% coal
80% gas-20% coal
60% gas-40% coal
40% gas-60% coal
20% gas- 80 % coal
0% gas-100% coal
Example: At 480,000 lb per hr steam flow, burning 400,000 cu ft of gas per hr, 68% of total fuel requirements are met by gas and 32% by coal

**AMOUNT OF GAS** in thousands of cubic feet, needed to carry different steam loads when mixed with coal, is pictured above

could be to supply more air here. But we looked farther.

We blew sawdust into the furnace under conditions similar to coal and air flow during operation. The flow patterns we observed led us to put guide vanes in the burner tubes to improve coal distribution from the lower burners. These vanes and a change in setting of the burner's lower auxiliary air ports during operation eliminated the CO in this area and no further wastage difficulty developed as a result.

**Corrosion and Pitting.** Toward the furnace sides where the tube temperatures run higher during operation, corrosion, checking and pitting took place on the outside of the lower superheater tubes in the bottom deck.

Continuous slag adhesion to the bottom surface of the tubes, followed by repeated cooling and cracking off of this layer of slag during soot-blowing, brought on corrosion, pitting and checking of the tube surface. To remove this problem, we put in stainless-steel semi-circular boats to protect the affected areas. Results have been fine.

**Plugged Preheaters.** Flyash build-up in a 12-ft section at outlet end of tubes causes considerable difficulty when firing pulverized coal. Sometimes as many as a third of the 3560 preheater tubes were plugged up completely. Every six months during continuous coal operation we shut down to clean them. Increasing the size of the recirculating air ducts to give a higher inlet air and warmer tube outlet reduced the flyash deposit rate

## I: COMPARISONS OF COAL USED AT OAK RIDGE PLANT

### Range Covers Years From April 1944 to January 1950

| | *Design* | *Actual** | *Average* |
|---|---|---|---|
| Moisture, % | 4.0 | 2 - 14 | 3.67 |
| Volatile matter, % | 34.9 | 29 - 40 | 34.36 |
| Fixed carbon, % | 52.7 | 42 - 60 | 49.04 |
| Ash, % | 8.4 | 4 - 24 | 12.93 |
| Sulfur, % | — | 0.5 - 3.5 | 2.62 |
| Btu per lb as received | 13,010 | 10,400 - 13,600 | 12,315 |
| Ash-softening temperature, F | 2200 - 2500 | 2250 - 2800 | 2460 |

*Actual gives variations from lowest reported amounts to the highest.

## II: DIFFERENCES IN COST OF COAL AND GAS

### The Years 1950-51 Include Combination Gas-Coal

| *Fiscal year* | *1948* | *1949* | *1950* | *1951* |
|---|---|---|---|---|
| Plant-capacity factor | 0.743 | 0.743 | 0.663 | 0.895 |
| *COAL:* | | | | |
| Average tons per hr | 85.0 | 83.1 | 34.2 | 11.4 |
| Average cost per ton, $ | 6.02 | 6.23 | 5.46 | 5.17 |
| Average cost per million Btu, $ | 0.249 | 0.252 | 0.221 | 0.209 |
| *GAS:* | | | | |
| Average MCF per hr | – | – | 980 | 2430 |
| Average cost per MCF, $ | – | – | 0.220 | 0.215 |
| Average cost per million Btu, $ | – | – | 0.208 | 0.200 |

but it has not been entirely eliminated.

**Coal pulverizers** give satisfactory service. For example, among the nine pulverizers minimum service has been 344,915 tons, and maximum 379,670.

The roll journals and classifiers caused no trouble during this period. The bull rings hung up a minimum record of 106,540 tons, and a maximum of 152,170. The false bottom in the bowl lasted for 222,858 tons as the minimum service, and 269,670 for the maximum. The rolls suffered the greatest wear of all. The first to go went after 68,982 tons, and the longest to hold out lasted for 96,100 tons.

The gear drive, including a bronze gear, worm gear, bearings for the worm shaft and for bowl thrust, went 250,146 tons for minimum service life, and 379,670 for maximum.

Exhauster and its parts had a rather checkered experience: The 4-wheel spider ran for 301,883 tons before the first one needed servicing, and 379,670 for the longest-running. The throat piece liner held out for 258,353 tons for the minimum, and 362,883 for the maximum. The liners themselves went out after 45,339 tons for the first one, and 134,703 for the last. The fan shroud stayed for 151,750 tons up to 208,043 for the maximum.

The whizzer blades began to need attention after 26,000 tons for the plain and 38,800 for the hard. The longest-lived went 57,900 tons for the plain, against 93,001 for the hard. In a similar way, the plain fan blades first dropped out at 44,220 tons, against 45,700 for the special-treated ones. But the long-time blades showed 55,700 tons of service for the plain, and 140,951 for the special-treated.

**2. OIL BURNING.** In 1946, when the strike put coal at a premium we put in a bunker-C fuel-oil system for No. 3 boiler. Two burner tips with steam jet tubes went into each of the four corners. These burners operate with a steam-atomizing pressure of 110 to 175 psi, and an oil pressure of 95 to 155 psi.

**Tip Selection.** One big problem in going over to oil firing was getting a burner tip that would give the right flame conditions and proper flow for a tangentially fired furnace. Our first tips combined with the jet tubes gave us a thin, concentrated cone of oil at two points in a long, narrow, vertical burner. As a result we had trouble getting a good air-fuel mixing at the burner.

After we replaced the original tips with smaller ones results were satisfactory. In fact, we could bring the boiler up to 825,000 lb per hr rating, against the maximum of 740,000 lb per hr our average 12,340 Btu coal could give us.

These oil burners went over as emergency back-ups for coal when we went back on coal after the strike.

**3. GAS BURNING.** Rising price of coal in 1948 led us to enter a contract for natural gas as a primary fuel, with coal as the supplementary and back-up fuel.

Gas reaches us through a 22-in. pipeline at 100 psi, and connects into a twin reducing station in the power station yard. Each of the two reducing valves can handle enough gas at 35 psi to carry maximum station load. An 18-in. header in the boiler room receives this gas and feeds the three boilers through individual 10-in. plug cocks, followed up by two emergency shut-off cocks with an automatic vent between them and a manual or automatic gas-control valve operated from the boiler board. This control valve reduces gas pressure to give from 1 to 5 psi, depending on load at the five burners, placed in each of the four corners of the boiler. Each of the five gas-burner sets is interspersed among three coal burners already in each corner.

A vertical header, vented at top and bottom at each corner of the boiler, delivers gas to the individual horizontal fish-tail burners through a connecting feeder pipe. Burners are moved up and down as furnace conditions require.

Our operation with gas as a fuel profited considerably from the preventive maintenance and safe-operating practices we had developed from our pulverized coal- and oil-burning experiences.

On first start-up with gas we took the precaution to blow the 22-in. main feed line from the gas company's reducing station to the yard reducing station to atmosphere for 7 min. Then we purged the gas line from here to the individual burner feeds with nitrogen.

Once under way we had little or no difficulty with gas firing. In fact, the operators enjoyed the exact steam-pressure control they had even during load changes. Further, we could get maximum steaming rate of 850,000 lb per hr, and still keep the superheater steam-outlet temperature within control.

Chief troubles we had in gas firing came from foreign material picked up in the new gas main. It cut out the internals of the yard reducing-station valve and on one occasion completely plugged the coal strainers ahead of the two yard reducing valves. When that happened gas flow to all three boilers dropped to zero inside of 4 min. Fortunately the operators were on top of the trouble. They cut in the coal pulveriz-

## III: TOTAL YEARLY PLANT OPERATING COSTS

### Mills Per Kilowatt-Hour Net Output

| | 1948 Coal | | 1949 Coal, gas | 1950 Gas | 1951 Gas | |
|---|---|---|---|---|---|---|
| | *Mills* | % | *Mills* | *Mills* | *Mills* | % |
| Supervision, labor | 0.422 | 8.7 | 0.447 | 0.452 | 0.312 | 8.4 |
| Water, aux power | 0.293 | 6.1 | 0.294 | 0.244 | 0.218 | 5.9 |
| Misc expenses | 0.128 | 2.7 | 0.069 | 0.047 | 0.031 | 0.8 |
| Maintenance | 0.337 | 7.0 | 0.451 | 0.632 | 0.253 | 6.9 |
| Total, excl fuel | 1.180 | 24.5 | 1.261 | 1.375 | 0.814 | 22.0 |
| Fuel cost | 2.811 | 58.5 | 2.930 | 2.473 | 2.410 | 65.3 |
| Total, incl fuel | 3.991 | 83.0 | 4.191 | 3.848 | 3.224 | 87.3 |
| Overhead | 0.825 | 17.0 | 0.913 | 0.813 | 0.468 | 12.7 |
| Total cost | 4.816 | 100.0 | 5.104 | 4.661 | 3.692 | 100.0 |

ers soon enough to stop the steam pressure at 825 psi so we held all load, although at reduced frequency.

With gas as a primary fuel we have gone to combination fuel firing. Gas and coal combination fires one boiler. Disadvantages of this system are: (1) 60% coal is the lowest that can be handled without running into difficulties with moisture in the flue gas and a resultant plugging up of the outlet end of preheater tubes by flyash. (2) Excess air amounts have to be carefully controlled or slag accumulates in the lower bank of superheater tubes. (3) Width of heat band in furnace has to be closely controlled to prevent slagging on the lower section of the furnace walls. (Temperature in this lower zone is raised by using two lower coal burners and two lower gas burners so heat band is narrowed and confined to lower section of furnace.)

**4. COMPARISONS.** In Tables I-IV you'll see the operating data for each type of fuel and, where possible, direct comparisons. Of the most interest to the power-plant operator are Tables III, IV.

Table III breaks down the different costs with the highly important one of maintenance reported. For 1948, when coal alone was used, and 1951, when gas held sway, individual costs are broken down in percent.

Table IV is a fairly comprehensive point-by-point comparison of boiler performance. The relatively high loss effect of hydrogen in gas compared to that in coal shows up sharply in the breakdown of losses and the tallying of efficiencies. But the much lower excess-air percentages and the close control of final superheat tend to overcome unit-efficiency shortcomings.

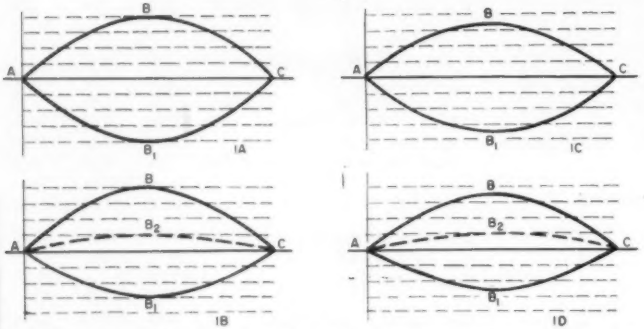
## IV: BOILER-PERFORMANCE COMPARISONS OF ALL THREE FUELS

| | *Gas* | *Coal* | *Oil* |
|---|---|---|---|
| Steam flow, lb per hr | 735,000 | 740,000 | 737,000 |
| Steam press. superheater outlet, psi | 1,320 | 1,278 | 1,339 |
| Total temp steam superheater outlet, F | 925 | 931 | 921 |
| Feed temp at economizer inlet, F | 357 | 356 | 350 |
| Gas temp at air-heater outlet, F | 289 | 326 | 298 |
| Losses: % | | | |
| Unburned carbon in refuse | 0.0 | 0.19 | 0 |
| Dry flue gas | 3.33 | 5.34 | 4.20 |
| Moisture in fuel | 0.0 | 0.24 | 0 |
| Burning $H_2$ to water | 10.68 | 3.87 | 6.61 |
| Moisture in air | 0.05 | 0.10 | 0.10 |
| Radiation and unaccounted for | 2.00 | 2.00 | 2.00 |
| Total | 16.06 | 11.74 | 12.91 |
| Efficiency steam-gen unit, % | 83.94 | 88.50 | 87.09 |
| Btu input, million per hr | 991.6 | 941.6 | 975.0 |
| Fuel burned per hr (HT balance) | MCF 914.8 | lb 76,305 | gal/hr 6,370 |
| Fuel burned per hr (metered) | 944.4 | 74,533 | 6,440 |
| Feed temp at economizer outlet, F | 494 | 545 | 520 |
| Gas temperature, F: | | | |
| Entering economizer | 1,162 | 1,250 | 1,178 |
| Leaving economizer | 516 | 575 | 550 |
| Air temperature, F: | | | |
| Ambient air to f-d fan | 108 | 96 | 100 |
| Recirculating air to f-d fan | – | – | – |
| Air to f-d fan | 108 | 106 | 104 |
| Air heater outlet | 400 | 474 | 420 |
| Excess air leaving economizer, % | 15.0 | 28.3 | 22.0 |
| Recirculating air damper open, % | 0 | 0 | 0 |
| Superheater bypass damper, % open | 39.0 | 79.0 | 56.0 |
| Btu release per cu ft per hr, furnace volume, 47,300 cu ft | 21,000 | 19,900 | 20,630 |
| Steam-press. drop through SH conn tubes to nonreturn valve discharge, psi | 55 | 47 | 36 |
| Gas resistance, in. water: | | | |
| Furnace, BCR and SH | 0.63 | 1.14 | 1.00 |
| Economizer | 3.83 | 3.73 | 3.15 |
| Air heater | 2.67 | 4.99 | 4.10 |
| Ducts | – | – | – |
| Total draft loss, in. water | 7.13 | 9.86 | 8.25 |
| Air resistance, inches $H_2O$: | | | |
| Air heater | 5.81 | 6.65 | 5.85 |
| Total draft loss, in. water | 9.75 | 11.32 | 12.00 |
| Gas leaving air heater, lb per hr | 841,000 | 944,000 | 960,000 |
| Air supplied, lb per hr | 813,000 | 877,000 | 890,500 |
| Average $CO_2$ economizer outlet | 10.3 | 14.3 | 13.0 |
| Average $CO_2 + O_2$ economizer outlet | 13.3 | 19.0 | 17.1 |
| F-d fan: (a) amperage | 55/65 | 65/64 | 68/68 |
| (b) rpm | 1190/ 1190 | 1215/ 1188 | 1230/ 1180 |
| I-d fan: (a) amperage | 99/ 110 | 112/ 112 | 108/ 110 |
| (b) rpm | 875/ 950 | 889/ 862 | 885/ 865 |

# ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

## 42—Electronic Control of Heating Systems: II




**1** Voltage on control grid of Tube $T_1$, Fig. 2, turns heat on and off. When balanced, *1A* and *1C*, heat is turned on; unbalanced, *1B* and *1D*, heat is turned off

► MANY HEATING JOBS, in small offices, stores, warehouses and apartment houses, don't have a suitable location for a thermostat. These building heating demands are adequately met by controlling the heating system according to outside temperature. If outside temperature goes down, more heat is supplied to the building. If it rises, less heat is provided.

**Outside-Temperature Control.** Fig. 2 diagrams a Minneapolis-Honeywell electronic system of building-heating control actuated by outside temperature (Cyclotrol). It comprises two wheatstone bridges, a cycler, a clock control, and a 2-stage amplifier with tube $T_1$ and $T_2$. Rectifying tube $T_4$, in the September article, has been replaced by the disk rectifier $R_6$.

**Two Bridge Circuits.** Bridge circuits on the left look a little complicated, but what we have to know about them is quite simple. Top bridge includes resistors $R_{15}$, $R_{16}$, $R_{17}$, $R_{18}$, and element $H_2$ in the cycler. Transformer secondary $S_6S_4$ energizes this bridge, from $S_6$ through $R_{15}$ and $H_2$ to $S_4$. The other circuit is through $R_{16}$, $R_{17}$, $R_{18}$ to $S_4$. Voltage across $R_{18}$ and the right-hand half of $R_{17}$, minus the drop across $R_{14}$ and $H_2$ is applied from contact $D$ on $R_{17}$ to the control grid and cathode of $T_1$, through $R_{13}$, $R_{14}$ and cycler element $H_2$ to $S_4$. Let curve $AB_1C$, Fig. *1A*, represent this bias.

Value of this voltage depends on the resistance of $H_2$ and consequently its temperature. When its temperature is low, voltage will be at a maximum. Conversely, when its temperature is high its resistance and volts drop are comparatively high, and the voltage from grid to cathode is low.

**Outdoor Element.** Lower bridge is energized by transformer secondary $S_5S_3$ from $S_5$ through resistors $R_{11}$, $R_{12}$, and outdoor element $R_7$ to $S_3$. The other circuit is from $S_5$ through $R_{10}$, $R_9$ and $R_8$ to $S_3$. Voltage across outdoor element $R_7$ is applied from $E$ through $R_8$, cathode to grid of $T_1$ to $D$, left-hand half of $R_{17}$, $R_{16}$, $R_{15}$, part of $R_{18}$ and $R_9$, $R_8$, and to $S_3$. This voltage can be represented by curve $ABC$, Fig. *1A*.

High outside temperature increases resistance of $R_7$ and voltage across it and from cathode to control grid of $T_1$. As outside temperature decreases so does resistance of $R_7$ and voltage across it, and the volts from cathode to control grid of $T_1$. What all this amounts to is that with the transformer polarity shown the top bridge tries to make the control grid of $T_1$ minus, while the bottom bridge tends to make it plus. When the two voltages are equal, as in Fig. *1A* there is no ac signal on the control grid.

The amplifying circuits are so arranged that when there is no signal on $T_1$, tube $T_2$ conducts and closes relay contacts $CR_1$ and $CR_2$. When plus bias on $T_1$ is increased to a certain value, a minus bias on $T_2$ reduces the current in relay coil $CR$ to where its contacts open.

When transformer polarity reverses, tube $T_2$ does not conduct, so we need not consider the signal put on the control grid of $T_1$ by the bridges. For this reason only the active half of the bridge signal voltages are shown in Fig. *1A*.

**Tube Circuits.** Amplifying tube $T_1$ is a pentode 5-element unit. Amplifying and power tube $T_2$ is a dual triode with the two groups of elements connected in parallel. For the polarity shown a circuit for $T_1$ is from $S_7$ through resistor $R_{19}$, cathode to anode of the tube, resistors $R_7$ $R_8$ to selenium rectifier $R_6$ to $S_6$.

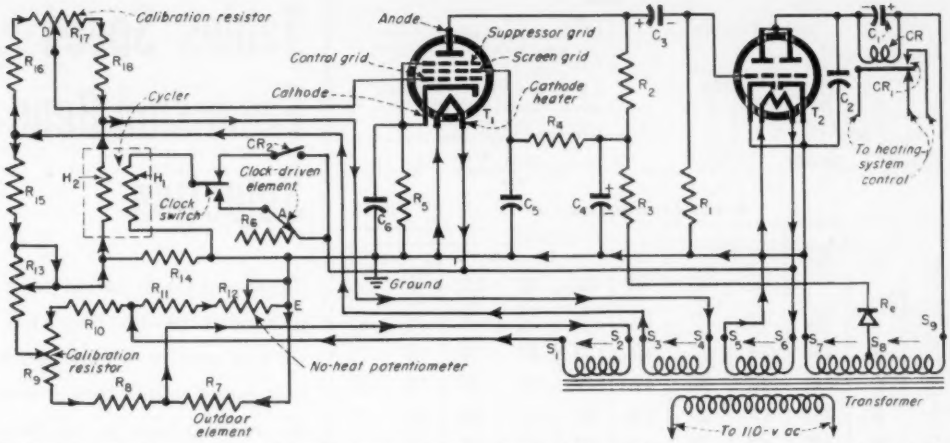
Capacitor $C_4$ is charged to the polarity shown, so on reverse transformer polarity it discharges through tube $T_1$ and resistor $R_{19}$. It therefore acts as a filter to smooth out the voltage and current flow through half-wave rectifier $R_6$.

For tube $T_2$ the circuit is from $S_7$ to cathodes and anodes of the tube, coil $CR$ to $S_6$. Capacitor $C_3$ is charged to the polarity shown. On reverse transformer polarity when $T_2$ does not conduct, this capacitor discharges through coil $CR$ to prevent the relay contacts from chattering.

**System Operation.** Assume the bridge voltages applied to the grid of $T_1$ are balanced for a given outside temperature, as in Fig. *1A*. As mentioned, when there is no signal voltage on the grid of $T_1$, tube $T_2$ conducts and closes relay contacts $CR_1$ to light the burner and $CR_2$ to energize the cycler.

Heating the cycler increases the resistance of $H_2$ and the voltage across it. Volts applied from the control grid to cathode of $T_1$ is the voltage across $R_{13}$, minus that across $R_{14}$ and $H_2$. Because of its increased temperature and resistance, voltage across $H_2$ increases. Consequently volts from the control grid to cathode of $T_1$ decrease.

As long as outside temperature remains constant, voltage across $R_7$ remains constant. Then with a decreasing minus and a constant plus bias, the difference puts a plus signal on the grid of $T_1$. This condition is represented in Fig. *1B*. Here the plus bias voltage curve




**2** Diagram of electronic system of building-heating control actuated by outdoor temperature. It comprises two wheatstone bridges, a cycler to control heating periods, a clock to switch from night to day heating, and a 2-stage amplifier

*ABC* is the same as in Fig. *1A*, but the minus curve $AB_1C$ is less. The difference between them, dotted curve $AB_2C$, is the plus signal on the control grid of $T_1$. This signal amplified puts a minus bias on the grid of $T_2$.

Assume that this signal reduces the voltage across *CR* to 25 v, at which point the relay opens its contacts to cut off the heat, and opens the cycler-heater circuit. The cycler starts to cool so resistance of and voltage across $H_3$ decreases. In time, bias voltages on the control grid of $T_1$ return to that of Fig. *1A*. Current flow through $T_2$ and coil *CR* again increases to a value that closes contacts $CR_1$ and $CR_2$, and the heating cycler is repeated. These on-and-off periods of the heating system are such as to hold room temperature practically constant as long as outdoor temperature's constant.

**Outdoor Temperature**. Assume outdoor temperature decreases. This decreases temperature and resistance of outdoor element $R_7$ and voltage across it. This reduces the plus bias on the control grid of tube $T_1$. Let curve *ABC*, Fig. *1C*, represent this voltage, which is less than in Fig. *1A* and *1B*. To put an equal minus voltage on the grid, curve $AB_1C$ and resistance of $H_3$ can be higher. Therefore, its temperature will be higher when heat is turned on and the cycler is energized. To turn off the heat, bias on grid of $T_1$, dotted curve $AB_2C$, Fig. *1D*, must be the same as in Fig. *1B*.

This means cycler temperature must be increased the same amount in Fig. *1D* as in Fig. *1B*. Since the cycler starts to heat at a higher temperature it will be at a higher temperature when the bias on $T_1$ and $T_2$ is high enough to open the relay. From this we see that a decreased outdoor temperature causes the cycler to operate at a higher temperature. Because the cycler is operating at a higher temperature it will lose heat faster to the surrounding air. It will, therefore, take longer to raise its temperature over the operating range. Then the heat will remain on longer than before outside temperature increased.

When heat is shut off and cycler starts to cool, being at a higher temperature it will cool faster and the heat will be shut off for shorter periods than before outside temperature decreased. This increased ON-heating and decreased OFF-heating period is enough to supply the added heat losses and maintain comfortable room conditions.

As outside temperature changes, cycler on and off periods change to supply the right amount of heat for comfortable inside temperature. Since heating needs are regulated by outside temperature, they are anticipated and supplied before an uncomfortable change in inside temperature occurs.

**Potentiometers**. No-heat potentiometer $R_{12}$ is connected in the bridge leg opposite the outdoor element $R_7$. A decrease in $R_{12}$ resistance has the same effect on the two bridges as an increase in temperature on the outdoor element. This requires a lower outdoor temperature to bring about a given cycler timing.

Full-heat potentiometer $R_{13}$ connects in series between the two bridges. It forms a voltage divider that permits impressing more or less of the total signal from the lower bridge on the upper one. The larger the portion of the lower-bridge signal impressed on the upper bridge, the greater the effect of a given change in outdoor temperature on the cycler's operation.

Potentiometers $R_9$ and $R_{11}$ are for calibrating the bridge system and are set at the factory. Potentiometers $R_{10}$ and $R_{13}$ connect to knobs so the control can be readily adjusted after installation to meet building heating needs.

**Night Operation.** In daytime, the clock switch is closed to the position shown and the clock-driven element is all the way to the right to cut $R_6$ out of circuit. At night shutdown, the clock trips the switch and it closes to the down contact. This continuously connects

(*Continued on page 194*)

## ELECTRONIC SERIES IN BOOK FORM

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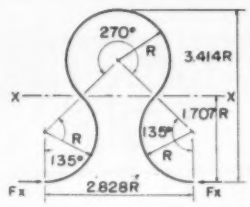
## Table I: Double-Offset Expansion Bend




*General:*

Length = $9.425R$

Modified Length = $9.425RK$

$$F_x = \frac{\Delta_x E M_B I_P}{1728 I_x}$$

$I_x$ (about gravity axis X-X) = $12.52R^3K$

*For Stress of* 10,000 *psi, E of* $29 \times 10^6$:

$$\text{Deflection} = \frac{0.728R^3K}{Dg} \text{ inches}$$

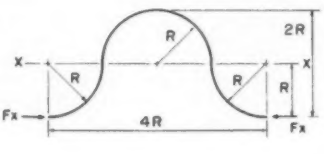
$$F_x = \frac{976 I_P}{RDg} \text{ pounds}$$

**For Stress of 10,000 psi, E of $29 \times 10^6$**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$ = $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.36 | 363 | 0.45 | 307 | 0.68 | 219 | 0.99 | 171 |
| | 80 | 0.218 | 0.27 | 461 | 0.37 | 376 | 0.61 | 276 | 0.91 | 219 |
| 3" | 40 | 0.216 | 0.56 | 785 | 0.72 | 627 | 1.07 | 452 | 1.53 | 350 |
| | 80 | 0.300 | 0.43 | 944 | 0.58 | 770 | 0.93 | 559 | 1.41 | 443 |
| 4" | 40 | 0.237 | 0.83 | 1080 | 1.00 | 913 | 1.59 | 646 | 2.24 | 501 |
| | 80 | 0.337 | 0.65 | 1380 | 0.84 | 1120 | 1.34 | 814 | 1.98 | 638 |
| 5" | 40 | 0.258 | 1.12 | 1435 | 1.45 | 1223 | 2.14 | 897 | 2.93 | 686 |
| | 80 | 0.375 | 0.86 | 1978 | 1.13 | 1504 | 1.76 | 1145 | 2.55 | 897 |
| 6" | 40 | 0.280 | 1.44 | 1783 | 1.90 | 1570 | 2.83 | 1192 | | |
| | 80 | 0.432 | 1.10 | 2743 | 1.39 | 2185 | 2.13 | 1569 | | |
| 8" | 40 | 0.322 | 2.11 | 2538 | 2.76 | 2279 | | | | |
| | 80 | 0.500 | 1.61 | 4170 | 2.09 | 3360 | | | | |
| 10" | 40 | 0.365 | 2.73 | 3400 | | | | | | |
| | 60 | 0.500 | 2.33 | 5190 | | | | | | |
| 12" | Std. | 0.375 | 3.47 | 3780 | | | | | | |
| | XS | 0.500 | 3.06 | 5830 | | | | | | |
| 14" | 30 | 0.375 | 4.46 | 3880 | | | | | | |
| | XS | 0.500 | 3.89 | 6020 | | | | | | |
| 16" | 30 | 0.375 | 5.02 | 3870 | | | | | | |
| | 40 | 0.500 | 4.71 | 6440 | | | | | | |
| 18" | 30 | 0.375 | 5.82 | 3970 | | | | | | |
| | XS | 0.500 | 5.54 | 6740 | | | | | | |
| 20" | 20 | 0.375 | 6.49 | 4020 | | | | | | |
| | 30 | 0.500 | 6.18 | 6770 | | | | | | |

| Temperature, °F | Q Factor 2"-8" Pipe | Q Factor 10"-20" Pipe |
|---|---|---|
| 300 | 1.50 | 1.46 |
| 400 | 1.46 | 1.41 |
| 500 | 1.42 | 1.37 |
| 600 | 1.38 | 1.33 |
| 700 | 1.34 | 1.29 |
| 800 | 1.31 | 1.25 |

## Table II: Expansion U-Bend




*General:*

Length = $6.283R$

Modified Length = $6.283RK$

$$F_x = \frac{\Delta_x E M_B I_P}{1728 I_x}$$

$I_x$ (about gravity axis X-X) = $3.14R^3K$

*For Stress of* 10,000 *psi, E of* $29 \times 10^6$:

$$\text{Deflection} = \frac{0.312R^3K}{Dg} \text{ inches}$$

$$F_x = \frac{1667 I_P}{RDg} \text{ pounds}$$

**For Stress of 10,000 psi, E of $29 \times 10^6$**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$ = $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.15 | 652 | 0.19 | 535 | 0.29 | 373 | 0.43 | 292 |
| | 80 | 0.218 | 0.12 | 787 | 0.16 | 642 | 0.26 | 472 | 0.39 | 373 |
| 3" | 40 | 0.216 | 0.34 | 1,337 | 0.31 | 1089 | 0.46 | 772 | 0.66 | 598 |
| | 80 | 0.300 | 0.19 | 1,612 | 0.25 | 1315 | 0.40 | 955 | 0.60 | 757 |
| 4" | 40 | 0.237 | 0.35 | 1,825 | 0.47 | 1557 | 0.68 | 1104 | 0.96 | 855 |
| | 80 | 0.337 | 0.28 | 2,374 | 0.36 | 1914 | 0.58 | 1300 | 0.85 | 1090 |
| 5" | 40 | 0.258 | 0.48 | 2,430 | 0.62 | 2080 | 0.92 | 1532 | 1.26 | 1172 |
| | 80 | 0.375 | 0.36 | 3,280 | 0.49 | 2722 | 0.75 | 1955 | 1.09 | 1532 |
| 6" | 40 | 0.280 | 0.62 | 3,050 | 0.81 | 2682 | 1.21 | 2035 | 1.63 | 1555 |
| | 80 | 0.432 | 0.47 | 4,680 | 0.60 | 3730 | 0.91 | 2681 | 1.34 | 2100 |
| 8" | 40 | 0.322 | 0.90 | 4,330 | 1.18 | 3800 | 1.78 | 3040 | | |
| | 80 | 0.500 | 0.69 | 7,130 | 0.87 | 5740 | 1.32 | 4120 | | |
| 10" | 40 | 0.365 | 1.17 | 5,810 | 1.54 | 5250 | | | | |
| | 60 | 0.500 | 1.00 | 8,870 | 1.28 | 7560 | | | | |
| 12" | Std. | 0.375 | 1.49 | 6,460 | 1.99 | 5970 | | | | |
| | XS | 0.500 | 1.31 | 9,950 | 1.73 | 8850 | | | | |
| 14" | 30 | 0.375 | 1.91 | 6,620 | | | | | | |
| | XS | 0.500 | 1.67 | 10,290 | | | | | | |
| 16" | 30 | 0.375 | 2.15 | 6,610 | | | | | | |
| | 40 | 0.500 | 2.02 | 11,000 | | | | | | |
| 18" | 30 | 0.375 | 2.49 | 6,780 | | | | | | |
| | XS | 0.500 | 2.37 | 11,510 | | | | | | |
| 20" | 20 | 0.375 | 2.78 | 6,870 | | | | | | |
| | 30 | 0.500 | 2.65 | 11,570 | | | | | | |

| Temperature, °F | Q Factor 2"-8" Pipe | Q Factor 10"-20" Pipe |
|---|---|---|
| 300 | 1.36 | 1.33 |
| 400 | 1.29 | 1.27 |
| 500 | 1.22 | 1.21 |
| 600 | 1.16 | 1.16 |

# Tables Speed Expansion-Bend Selection

**These new tables permit you to pick pipe expansion bends easily and quickly without much calculation. Save time today by learning how to use them**

By S W SPIELVOGEL, *Asst Div Engr*
*Consolidated Edison Co of New York*

► THESE TABLES, abridged and reprinted with permission of Grinnell Company, Inc, from their recently published book, *Piping Design and Engineering*, permit selection of bends designed to absorb expansion between two fixed points. Tabulated deflections and anchor forces produce a maximum bending stress of 10,000 psi with a modulus of elasticity, $E$, of $29 \times 10^6$ psi when the tangents are restrained from rotation as in Fig. 1. But as the examples show, it is possible to convert to any desired working stress and temperature, as well as to unguided pipe, Fig. 2. Tabulated values have been calculated by the author's method explained in more detail in *Piping Stress Calculations Simplified.**

**Guided Tangents.** These tangents, Fig. 1, don't contribute to flexibility; the bend absorbs the expansion between pipe terminals. Problems involving this type are solved by selecting from the table a bend having a tabular deflection greater than or equal to (10,000) × (actual expansion, in.) × ($M_B$) ÷ allowable stress, psi. Actual anchor force then = (tabular anchor force, lb) × (actual deflection, in.) × ($M_B$) ÷ tabular deflection, in. Values for these re-

* Published by the author

**1** **RESTRAINED TANGENTS** don't contribute to piping-system flexibility

lations are obtained from the proper bend table and Table VIII, p 99, where $M_B$ is defined.

**Unguided Tangents.** Since the straight run in Fig. 2 is not restrained, it contributes to flexibility and less pipe is needed. With this condition select a bend so that the product of tabular deflection, in. and $Q$, equals or is greater than (10,000) × (actual expansion, in.) × ($M_B$) ÷ allowable stress, psi. For values of $Q$ see the lower right-hand corner of bend tables, I-VII.

**Bend-Table Use.** Easiest way to learn how to use these tables is by solving a few typical problems.

Example 1: A fully guided 6 in. Sch 40 carbon-steel pipeline operating at 425 F is to be installed between two fixed points 85 ft apart. Select a suitable bend so that bending stress does not exceed 13,110 psi. What are the anchor forces?

Solution: From a table of thermal expansion of pipe, as found in handbooks and catalogs, expansion at 425 F is 2.95 in. per 100 ft. Total expansion of this pipe is (2.95 in.) × (85 ft) ÷ 100 ft = 2.51 in. From Table VIII, $M_B = 0.946$ for carbon-steel pipe at 425 F. Tabular deflection, as stated above, should equal or be greater than (2.51) × (10,000) × (0.946) ÷ 13,110 = 1.81 in.

Refer to the tables to find bends accommodating a deflection of 1.81 in. The following four bends satisfy the conditions of the problem: Double-offset bend, $R = 6D_o$, tabular deflection = 1.9 in., anchor force = 1570 lb. Expansion U-bend, tangents = 2 ft, $R = 10\ D_o$, deflection = 2.16 in., anchor force = 1297 lb. Expansion U-bend, tangent = $R$, $R = 8D_o$, deflection = 2.27 in., anchor force = 1357 lb. Expansion U-bend, tangent = $2R$, $R = 6D_o$, deflection = 2.36 in., anchor force = 1340 lb. Actual anchor force for bend is product of tabular anchor force, total expansion and $M_B$ divided by tabular deflection. For the double-offset bend this is (1570) × (2.51) × (0.946) ÷ 1.9 = 1963 lb. Similar conversion gives 1425, 1420 and 1349 lb for the other bends.

Example 2: Assume we have the same conditions as in Example 1 except that the tangents are not guided. Find suitable bends and their anchor forces.

Solution: With unguided tangents we

**2** **UNRESTRAINED TANGENTS** have run of pipe that is unguided, are shorter

## Table III: Expansion U-Bend (Tangents = 2 ft)

*General:*

Length = $6.283R + 4$ ft

Modified Length = $6.283RK + 4$ ft

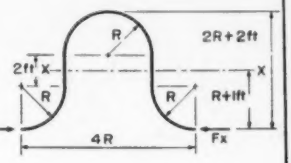
$F_x = \dfrac{\Delta_t E M_B I_P}{1728 I_x}$

$I_x$ (about gravity axis $X$-$X$) = $3.14R^3K + 8R^2K + 6.28RK + 1.33$

*For Stress of 10,000 psi, E of 29 × 10⁶:*

Deflection = $\dfrac{(0.312R^3 + 0.795R^2 + 0.624R)K}{(R+1)D\delta}$ + $\dfrac{0.132}{(R+1)D\delta}$ inches

$F_x = \dfrac{1667 I_P}{(R+1)D\delta}$ pounds




**For Stress of 10,000 psi, E of 29 × 10⁶**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$: $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.32 | 296 | 0.57 | 262 | 0.70 | 213 | 0.89 | 182 |
| | 80 | 0.218 | 0.40 | 357 | 0.47 | 324 | 0.62 | 269 | 0.81 | 233 |
| 3" | 40 | 0.216 | 0.60 | 742 | 0.68 | 653 | 0.86 | 514 | 1.11 | 428 |
| | 80 | 0.300 | 0.47 | 806 | 0.55 | 789 | 0.75 | 637 | 1.02 | 540 |
| 4" | 40 | 0.237 | 0.73 | 1,141 | 0.88 | 1088 | 1.12 | 803 | 1.44 | 658 |
| | 80 | 0.337 | 0.58 | 1,483 | 0.68 | 1275 | 0.94 | 1011 | 1.28 | 838 |
| 5" | 40 | 0.258 | 0.86 | 1,656 | 1.04 | 1402 | 1.38 | 1178 | 1.75 | 945 |
| | 80 | 0.375 | 0.69 | 2,283 | 0.82 | 1945 | 1.13 | 1505 | 1.53 | 1236 |
| 6" | 40 | 0.280 | 1.04 | 2,175 | 1.25 | 2012 | 1.71 | 1628 | 2.16 | 1297 |
| | 80 | 0.432 | 0.79 | 3,350 | 0.93 | 2760 | 1.29 | 2145 | 1.77 | 1754 |
| 8" | 40 | 0.322 | 1.35 | 3,330 | 1.67 | 3110 | 2.33 | 2737 | | |
| | 80 | 0.500 | 1.04 | 5,480 | 1.23 | 4590 | 1.72 | 3470 | | |
| 10" | 40 | 0.365 | 1.63 | 4,680 | 2.04 | 4370 | | | | |
| | 60 | 0.500 | 1.30 | 7,150 | 1.70 | 6300 | | | | |
| 12" | Std. | 0.375 | 1.97 | 5,300 | 2.52 | 5110 | | | | |
| | XS | 0.500 | 1.74 | 8,290 | 2.20 | 7590 | | | | |
| 14" | 30 | 0.375 | 2.44 | 5,650 | | | | | | |
| | XS | 0.500 | 2.13 | 8,760 | | | | | | |
| 16" | 30 | 0.375 | 2.67 | 5,740 | | | | | | |
| | 10 | 0.500 | 2.50 | 9,560 | | | | | | |
| 18" | 30 | 0.375 | 3.03 | 5,980 | | | | | | |
| | XS | 0.500 | 2.88 | 10,150 | | | | | | |
| 20" | 20 | 0.375 | 3.32 | 6,140 | | | | | | |
| | 30 | 0.500 | 3.16 | 10,330 | | | | | | |

| Temperature, °F | Q Factor: 2"-8" Pipe | Q Factor: 10"-20" Pipe |
|---|---|---|
| 300 | 1.42 | 1.35 |
| 400 | 1.37 | 1.29 |
| 500 | 1.33 | 1.24 |
| 600 | 1.29 | 1.19 |

## Table IV: Expansion U-Bend (Tangents = R)

*General:*

Length = $8.283R$

Modified Length = $6.283RK + 2R$

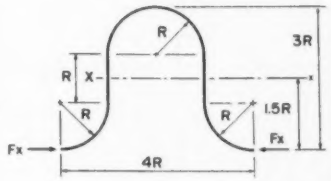
$F_x = \dfrac{\Delta_t E M_B I_P}{1728 I_x}$

$I_x$ (about gravity axis $X$-$X$) = $(8.715K + 0.167)R^3$

*For Stress of 10,000 psi, E of 29 × 10⁶:*

Deflection = $\dfrac{(0.577K + 0.011)R^2}{D\delta}$ inches

$F_x = \dfrac{1111 I_P}{RD\delta}$ pounds

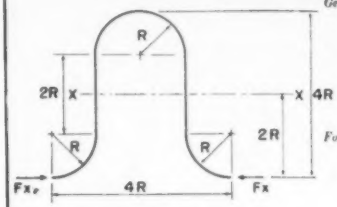



**For Stress of 10,000 psi, E of 29 × 10⁶**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$: $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.29 | 434 | 0.37 | 350 | 0.55 | 249 | 0.80 | 194 |
| | 80 | 0.218 | 0.22 | 524 | 0.30 | 428 | 0.49 | 314 | 0.74 | 249 |
| 3" | 40 | 0.216 | 0.45 | 891 | 0.58 | 725 | 0.86 | 514 | 1.23 | 399 |
| | 80 | 0.300 | 0.35 | 1074 | 0.47 | 877 | 0.75 | 637 | 1.14 | 504 |
| 4" | 40 | 0.237 | 0.66 | 1217 | 0.88 | 1038 | 1.28 | 735 | 1.80 | 570 |
| | 80 | 0.337 | 0.52 | 1562 | 0.68 | 1275 | 1.08 | 927 | 1.60 | 727 |
| 5" | 40 | 0.258 | 0.90 | 1633 | 1.16 | 1392 | 1.72 | 1021 | 2.36 | 781 |
| | 80 | 0.375 | 0.71 | 2252 | 0.91 | 1814 | 1.42 | 1303 | 2.06 | 1021 |
| 6" | 40 | 0.280 | 1.15 | 2030 | 1.52 | 1788 | 2.27 | 1357 | 3.06 | 1037 |
| | 80 | 0.432 | 0.88 | 3120 | 1.12 | 2488 | 1.72 | 1789 | 2.51 | 1400 |
| 8" | 40 | 0.322 | 1.69 | 2980 | 2.21 | 2504 | 3.34 | 2036 | | |
| | 80 | 0.500 | 1.30 | 4750 | 1.63 | 3620 | 2.48 | 2745 | | |
| 10" | 40 | 0.365 | 2.18 | 3870 | 2.87 | 3500 | | | | |
| | 60 | 0.500 | 1.86 | 5910 | 2.41 | 5040 | | | | |
| 12" | Std. | 0.375 | 2.77 | 4310 | 3.70 | 3980 | | | | |
| | XS | 0.500 | 2.45 | 6630 | 3.24 | 5900 | | | | |
| 14" | 30 | 0.375 | 3.56 | 4410 | | | | | | |
| | XS | 0.500 | 3.11 | 6860 | | | | | | |
| 16" | 30 | 0.375 | 4.00 | 4400 | | | | | | |
| | 40 | 0.500 | 3.76 | 7330 | | | | | | |
| 18" | 30 | 0.375 | 4.64 | 4520 | | | | | | |
| | XS | 0.500 | 4.42 | 7670 | | | | | | |
| 20" | 20 | 0.375 | 5.17 | 4580 | | | | | | |
| | 30 | 0.500 | 4.93 | 7710 | | | | | | |

| Temperature, °F | Q Factor: 2"-8" Pipe | Q Factor: 10"-20" Pipe |
|---|---|---|
| 300 | 1.41 | 1.32 |
| 400 | 1.37 | 1.28 |
| 500 | 1.33 | 1.25 |
| 600 | 1.29 | 1.22 |

## Table V: Expansion U-Bend (Tangents = 2R)




*General:*

Length = $10.283R$

Modified Length = $6.283RK + 4R$

$F_x = \dfrac{\Delta_x E M_B I_P}{1728 I_x}$

$I_x$ (about gravity axis $X$-$X$) $= (17.42K + 1.333)R^3$

*For Stress of* 10,000 *psi, E of* $29 \times 10^6$:

Deflection $= \dfrac{(0.865K + 0.0662)R^3}{DI}$ inches

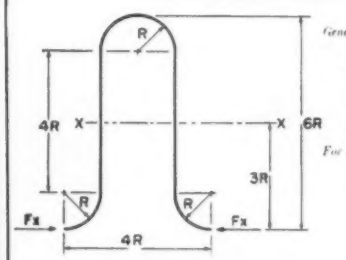
$F_x = \dfrac{833 I_P}{RDI}$ pounds

**For Stress of 10,000 psi, E of $29 \times 10^6$**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$ $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.45 | 326 | 0.57 | 262 | 0.87 | 187 | 1.26 | 146 |
| | 80 | 0.218 | 0.35 | 243 | 0.47 | 201 | 0.77 | 230 | 1.16 | 187 |
| 2½" | 40 | 0.203 | 0.53 | 483 | 0.69 | 396 | 1.07 | 280 | 1.56 | 219 |
| | 80 | 0.276 | 0.44 | 369 | 0.59 | 465 | 0.98 | 342 | 1.47 | 271 |
| 3" | 40 | 0.216 | 0.70 | 668 | 0.90 | 544 | 1.36 | 386 | 1.94 | 289 |
| | 80 | 0.300 | 0.55 | 806 | 0.74 | 657 | 1.19 | 477 | 1.79 | 378 |
| 3½" | 40 | 0.226 | 0.87 | 786 | 1.14 | 655 | 1.67 | 465 | 2.38 | 360 |
| | 80 | 0.318 | 0.68 | 985 | 0.89 | 795 | 1.43 | 578 | 2.15 | 457 |
| 4" | 40 | 0.237 | 1.03 | 912 | 1.36 | 778 | 2.01 | 551 | 2.83 | 427 |
| | 80 | 0.337 | 0.82 | 1186 | 1.09 | 956 | 1.70 | 695 | 2.52 | 545 |
| 5" | 40 | 0.258 | 1.39 | 1225 | 1.84 | 1044 | 2.69 | 766 | 3.70 | 586 |
| | 80 | 0.375 | 1.10 | 1688 | 1.43 | 1360 | 2.23 | 977 | 3.25 | 766 |
| 6" | 40 | 0.280 | 1.78 | 1522 | 2.36 | 1340 | 3.54 | 1017 | | |
| | 80 | 0.432 | 1.37 | 2341 | 1.75 | 1865 | 2.70 | 1339 | | |
| 8" | 40 | 0.322 | 2.59 | 2106 | 3.42 | 1945 | | | | |
| | 80 | 0.500 | 2.02 | 3360 | 2.55 | 2868 | | | | |
| 10" | 40 | 0.365 | 3.34 | 2901 | | | | | | |
| | 60 | 0.500 | 2.88 | 4430 | | | | | | |

| Temperature, °F | *Q* Factor 2"-10" Pipe Inclusive $5D_o$ & $6D_o$ | $8D_o$ & $10D_o$ |
|---|---|---|
| 300 | 1.40 | 1.48 |
| 400 | 1.36 | 1.45 |
| 500 | 1.33 | 1.42 |
| 600 | 1.30 | 1.40 |

## Table VI: Expansion U-Bend (Tangents = 4R)




*General:*

Length = $14.283R$

Modified Length = $6.283RK + 8R$

$F_x = \dfrac{\Delta_x E M_B I_P}{1728 I_x}$

$I_x$ (about gravity axis $X$-$X$) $= (44.27K + 10.66)R^3$

*For Stress of* 10,000 *psi, E of* $29 \times 10^6$:

Deflection $= \dfrac{(1.405K + 0.353)R^3}{DI}$ inches

$F_x = \dfrac{556 I_P}{RDI}$ pounds

**For Stress of 10,000 psi, E of $29 \times 10^6$**

| Pipe Size $D_o$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$ $5D_o$ Deflection, in. | $5D_o$ Anchor Force, lb | $6D_o$ Deflection, in. | $6D_o$ Anchor Force, lb | $8D_o$ Deflection, in. | $8D_o$ Anchor Force, lb | $10D_o$ Deflection, in. | $10D_o$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.84 | 217 | 1.08 | 175 | 1.66 | 125 | 2.43 | 97 |
| | 80 | 0.218 | 0.66 | 302 | 0.90 | 214 | 1.49 | 157 | 2.26 | 125 |
| 2½" | 40 | 0.203 | 1.00 | 322 | 1.30 | 260 | 2.06 | 187 | 3.01 | 146 |
| | 80 | 0.276 | 0.84 | 360 | 1.13 | 310 | 1.89 | 228 | 2.86 | 181 |
| 3" | 40 | 0.216 | 1.32 | 446 | 1.70 | 363 | 2.59 | 257 | 3.74 | 200 |
| | 80 | 0.300 | 1.05 | 538 | 1.41 | 439 | 2.30 | 319 | 3.47 | 252 |
| 3½" | 40 | 0.226 | 1.63 | 524 | 2.12 | 437 | 3.19 | 310 | 4.56 | 240 |
| | 80 | 0.318 | 1.29 | 656 | 1.70 | 538 | 2.76 | 386 | 4.17 | 305 |
| 4" | 40 | 0.237 | 1.91 | 680 | 2.56 | 519 | 3.82 | 368 | | |
| | 80 | 0.337 | 1.55 | 792 | 2.03 | 638 | 3.28 | 404 | | |
| 5" | 40 | 0.258 | 2.57 | 817 | 3.37 | 697 | | | | |
| | 80 | 0.375 | 2.08 | 1127 | 2.72 | 908 | | | | |
| 6" | 40 | 0.280 | 3.29 | 1016 | 4.37 | 885 | | | | |
| | 80 | 0.432 | 2.59 | 1562 | 3.33 | 1245 | | | | |

| Temperature, °F | *Q* Factor 2"-6" Pipe Inclusive $5D_o$ & $6D_o$ | $8D_o$ & $10D_o$ |
|---|---|---|
| 300 | 1.49 | 1.58 |
| 400 | 1.46 | 1.56 |
| 500 | 1.43 | 1.54 |
| 600 | 1.40 | 1.52 |
| 700 | 1.38 | 1.50 |
| 800 | 1.36 | 1.48 |

## PIPE-BEND TABLES

*continued*

select a bend so the product of tabular deflection and $Q$ equals or is greater than 1.81 in.

The following five bends satisfy this condition: Double-offset bend, $R = 5D_o$, $(Q) \times$ (tab. deflec) = 2.09 in. Expansion U-bend, $R = 10D_o$, $(Q) \times$ (tab. deflec) = 2.07 in. Expansion U-bend, tangents = 2 ft. $R = 8D_o$, $(Q) \times$ (tab. deflec) = 2.07 in. Expansion U-bend, tangents = $R$, $R = 6D_o$, $(Q) \times$ (tab. deflec) = 2.07 in. Expansion U-bend, tangent = $2R$. $R = 5D_o$, $(Q) \times$ (tab. deflec) = 2.4 in.

Tabular anchor forces for these bends, in the same order, are 1783, 1555, 1628, 1788 and 1522 lb. Actual anchor force for the double-offset bend is (1783) $\times$ (2.51) $\times$ (0.946) $\div$ 1.44 (1.45) = 2030 lb. Note that the denominator of this expression is the product of tabular deflection and $Q$ for the bend. By similar conversion the anchor forces for the other bends are 1787, 1660, 2055 and 1508 lb. Expansion U-bend is shortest bend for the job, having a developed length of 96.4 ft. Double-offset bend is longest, total length being 101.5 ft.

**Multiple Bends.** Where deflection is greater than can be handled by one bend, two or more bends may be chosen. These tables can be used for selecting multiple bends, with tangents restrained or unrestrained. Here are two problems showing table use.

Example 3: A fully guided straight 3 in. Sch 80 carbon-steel pipeline operating at 550 F is to be installed between two fixed points 235 ft apart. Find the number of suitable bends needed, anchor spacing and anchor force if allowable stress is 14,820 psi and headroom clearance limits bend height to about 5 ft.

Solution: Thermal expansion is 4.11 in. per 100 ft at 550 F. Total expansion of pipe is (4.11 in.) $\times$ (235 ft) $\div$ 100 ft = 9.66 in. Modulus ratio, $M_R$, from Table VIII, = 0.922.

Using a procedure similar to Example 1, but remembering that more than one bend will be needed: (tabular deflection) $\times$ (number of bends) should equal or be greater than (9.66) $\times$ (10,000) $\times$ (0.922) $\div$ 14,820 = 6.01 in. Hence, number of bends = 6.01 $\div$ tabular deflection, in.

Several solutions are possible, two of which are as follows: (1) Double-offset U-bend, $R = 6D_o$, tabular deflection = 0.58 in. Number of bends needed = 6.01 $\div$ 0.58 = 11. Actual deflection of each bend = 9.66 $\div$ 11 = 0.878 in. Anchor spacing = 235 $\div$ 11 = 21.4 ft closely. Bend height = 5.1 ft. Tabular anchor force = 770 lb. Actual force is found in a manner similar to that in

Example 1 and is (770) × (0.878) × (0.922) ÷ 0.58 = 1074 lb. Total developed length of bends is 343.2 ft.

(2) Expansion U-bend, tangents = 2 ft, $R = 6D_n$, tabular deflection = 0.55 in. Number of bends needed = 6.01 ÷ 0.55 = 11. Actual deflection = 9.66 ÷ 11 = 0.878 in. Anchor spacing is the same as before, 21.4 ft. Bend height is 5 ft. Tabular anchor force is 789 lb, actual anchor force 1160 lb. Total developed length is 316.8 ft.

These results show that the expansion U requires less material but has a slightly higher anchor force. All bends of a given height will show about the same deflection and anchor-force values so final choice depends on labor and material costs.

Example 4: Assume we have the same conditions as in Example 3 except that the tangents are unguided, that is unrestrained. Solve for number of bends needed and anchor forces.

Solution: Bend having the largest $Q$-factor gives maximum anchor spacing. Using the two bends of Example 3 to demonstrate the procedure, an approximate solution is as follows: For the double-offset bend, $Q = 1.4$. Number of bends = 6.01 ÷ (0.58) × (1.4), or 8. Actual deflection is 9.66 ÷ 8 = 1.2 in. Introducing $Q$ into the anchor-force relation we find the actual anchor force to be 1059 lb. Total developed length is 313.8 ft.

For the expansion U-bend, tangents = 2 ft, $Q = 1.31$. Number of bends = 6.01 ÷ (0.55) × (1.31) = 9. Actual deflection = 9.66 ÷ 9 = 1.07 in. Actual anchor force = 1080 lb. Total developed length = 301.7 ft. Note here that although bends of the same height show about the same tabular deflection the $Q$ factors vary considerably.

**Formula Solutions.** General equations on bend charts permit calculation of deflection and anchor force for radii not listed in the tables. Symbols used in these equations are: $D$ = outside dia of pipe., $D_n$ = nominal pipe size, in.; $E$ = modulus of elasticity at 70 F, psi; $F_x$ = force along $x$ axis, lb; $I_p$ = moment of inertia of pipe cross-section, in.$^4$, $I_x$ = moment of inertia of bend about $x$ axis; $K$ = flexibility factor for curved pipe; $L$ = distance between anchors, ft; $M_R$ = modulus ratio from Table VIII; $R$ = mean radius of bend, ft; $\beta$ = stress intensification factor; $A_x$ = total thermal expansion, in.

Future articles will present similar easy-to-use tables suitable for many different pipe shapes in one, two and three planes.

*Tables and examples reprinted from* Piping Design and Engineering, *copyright 1951 by Grinnell Company, Inc.*

## Table VII: Circle Bend

*General:*

Length = $6.283R$

Modified Length = $6.283RK$

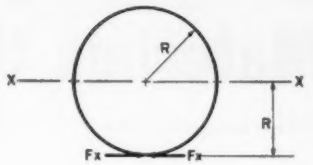
$$F_x = \frac{\Delta_x E M_R I_P}{1728 I_x}$$

$I_x$ (about gravity axis X-X) = $3.14R^3K$

*For Stress of* 10,000 *psi, E of* $29 \times 10^6$:

$$\text{Deflection} = \frac{0.312R^2K}{D\beta} \text{ inches}$$

$$F_x = \frac{1667 I_P}{RD\beta} \text{ pounds}$$




**For Stress of 10,000 psi, E of $29 \times 10^6$**

| Pipe Size $D_n$ | Sch. No. | Wall Thickness $t$, in. | Radius of Bend $R$ = 5$D_n$ Deflection, in. | 5$D_n$ Anchor Force, lb | 6$D_n$ Deflection, in. | 6$D_n$ Anchor Force, lb | 8$D_n$ Deflection, in. | 8$D_n$ Anchor Force, lb | 10$D_n$ Deflection, in. | 10$D_n$ Anchor Force, lb |
|---|---|---|---|---|---|---|---|---|---|---|
| 2" | 40 | 0.154 | 0.15 | 602 | 0.19 | 535 | 0.29 | 373 | 0.43 | 292 |
| | 80 | 0.218 | 0.12 | 787 | 0.16 | 642 | 0.26 | 472 | 0.39 | 373 |
| 2½" | 40 | 0.203 | 0.18 | 967 | 0.23 | 780 | 0.36 | 500 | 0.52 | 438 |
| | 80 | 0.276 | 0.15 | 1,139 | 0.20 | 930 | 0.33 | 983 | 0.49 | 542 |
| 3" | 40 | 0.216 | 0.24 | 1,337 | 0.31 | 1080 | 0.46 | 772 | 0.66 | 598 |
| | 80 | 0.300 | 0.19 | 1,612 | 0.25 | 1315 | 0.40 | 955 | 0.60 | 757 |
| 3½" | 40 | 0.226 | 0.30 | 1,572 | 0.38 | 1310 | 0.57 | 930 | 0.80 | 720 |
| | 80 | 0.318 | 0.22 | 1,972 | 0.30 | 1900 | 0.48 | 1157 | 0.72 | 915 |
| 4" | 40 | 0.237 | 0.35 | 1,825 | 0.47 | 1557 | 0.68 | 1104 | 0.98 | 855 |
| | 80 | 0.337 | 0.28 | 2,374 | 0.36 | 1914 | 0.58 | 1300 | 0.85 | 1000 |
| 5" | 40 | 0.258 | 0.48 | 2,450 | 0.62 | 2080 | 0.92 | 1532 | | |
| | 80 | 0.375 | 0.38 | 3,280 | 0.49 | 2722 | 0.75 | 1955 | | |
| 6" | 40 | 0.280 | 0.62 | 3,060 | 0.81 | 2682 | | | | |
| | 80 | 0.432 | 0.47 | 4,080 | 0.60 | 3730 | | | | |
| 8" | 40 | 0.322 | 0.90 | 4,330 | | | | | | |
| | 80 | 0.500 | 0.69 | 7,130 | | | | | | |
| 10" | 40 | 0.365 | 1.17 | 5,810 | | | | | | |
| | 60 | 0.500 | 1.00 | 8,870 | | | | | | |
| 12" | Std. | 0.375 | 1.49 | 6,460 | | | | | | |
| | XS | 0.500 | 1.31 | 9,950 | | | | | | |
| 14" | 30 | 0.375 | 1.91 | 6,620 | | | | | | |
| | XS | 0.500 | 1.67 | 10,290 | | | | | | |
| 16" | 30 | 0.375 | 2.15 | 6,610 | | | | | | |
| | 40 | 0.500 | 2.02 | 11,000 | | | | | | |
| 18" | 30 | 0.375 | 2.99 | 6,790 | | | | | | |
| | XS | 0.500 | 2.37 | 11,510 | | | | | | |
| 20" | 20 | 0.375 | 2.78 | 6,870 | | | | | | |
| | 30 | 0.500 | 2.65 | 11,570 | | | | | | |

| Temperature, °F | Q Factor, 2"-20" Pipe inclusive |
|---|---|
| 300 | 1.29 |
| 400 | 1.35 |
| 500 | 1.32 |
| 600 | 1.29 |

## Table VIII: Modulus Ratio, $M_R$

| Temp., $T$, °F | Carbon Steel | Carbon Moly Steel | ½% Cr, ½% Mo. Steel | 1-1½% Cr, ½% Mo. Steel | 2¼% Cr, 1% Mo. Steel | 4-6% Cr, 1% Mo. Steel | 18% Cr, 8% Ni. Steel | 25% Cr, 12% Ni. Steel | 25% Cr, 20% Ni. Steel | 28 Aluminum |
|---|---|---|---|---|---|---|---|---|---|---|
| 70 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 100 | 0.997 | 0.997 | 0.997 | 0.997 | 0.997 | 0.997 | 0.997 | 0.997 | 0.997 | 0.995 |
| 150 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.990 | 0.983 |
| 200 | 0.982 | 0.982 | 0.982 | 0.982 | 0.982 | 0.982 | 0.982 | 0.982 | 0.982 | 0.972 |
| 250 | 0.974 | 0.974 | 0.974 | 0.974 | 0.974 | 0.974 | 0.974 | 0.974 | 0.974 | 0.960 |
| 300 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.950 |
| 350 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.958 | 0.930 |
| 400 | 0.950 | 0.950 | 0.950 | 0.950 | 0.950 | 0.950 | 0.950 | 0.950 | 0.950 | 0.900 |
| 450 | 0.941 | 0.941 | 0.941 | 0.941 | 0.941 | 0.941 | 0.941 | 0.941 | 0.941 | |
| 500 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | 0.932 | |
| 550 | 0.922 | 0.922 | 0.922 | 0.922 | 0.922 | 0.922 | 0.922 | 0.922 | 0.922 | |
| 600 | 0.910 | 0.912 | 0.912 | 0.912 | 0.912 | 0.912 | 0.910 | 0.910 | 0.910 | |
| 650 | 0.895 | 0.902 | 0.902 | 0.902 | 0.902 | 0.902 | 0.895 | 0.895 | 0.895 | |
| 700 | 0.878 | 0.891 | 0.891 | 0.891 | 0.891 | 0.891 | 0.878 | 0.878 | 0.878 | |
| 750 | 0.856 | 0.879 | 0.879 | 0.879 | 0.879 | 0.879 | 0.856 | 0.856 | 0.856 | |
| 775 | 0.843 | 0.872 | 0.872 | 0.872 | 0.872 | 0.872 | 0.843 | 0.843 | 0.843 | |
| 800 | | 0.865 | 0.865 | 0.865 | 0.865 | 0.865 | 0.828 | 0.828 | 0.828 | |
| 825 | | 0.857 | 0.857 | 0.857 | 0.857 | 0.857 | 0.811 | 0.811 | 0.811 | |
| 850 | | 0.849 | 0.849 | 0.849 | 0.849 | 0.849 | 0.791 | 0.791 | 0.791 | |
| 875 | | 0.840 | 0.840 | 0.840 | 0.840 | 0.840 | 0.768 | 0.768 | 0.768 | |
| 900 | | | 0.831 | 0.831 | 0.831 | 0.831 | 0.743 | 0.743 | 0.743 | |
| 925 | | | 0.820 | 0.820 | 0.820 | 0.820 | 0.718 | 0.718 | 0.718 | |
| 950 | | | 0.808 | 0.808 | 0.808 | 0.808 | 0.692 | 0.692 | 0.692 | |
| 975 | | | 0.795 | 0.795 | 0.795 | 0.795 | 0.666 | 0.666 | 0.666 | |
| 1000 | | | | 0.782 | 0.782 | 0.782 | 0.640 | 0.640 | 0.640 | |
| 1050 | | | | | 0.753 | 0.753 | 0.588 | 0.588 | 0.588 | |
| 1100 | | | | | 0.723 | 0.723 | 0.536 | 0.536 | 0.536 | |
| 1150 | | | | | | 0.693 | 0.484 | 0.484 | 0.484 | |

$$M_R = \frac{E \text{ at temperature } T}{E \text{ at } 70° \text{ F}}$$

**MODULUS OF ELASTICITY, $E$, AT 70° F**

| | | | |
|---|---|---|---|
| Carbon Steel | $29 \times 10^6$ | 4 to 6% Cr., 1% Mo. Steel | $29 \times 10^6$ |
| Carbon Moly Steel | $29 \times 10^6$ | 31% Ni. Steel | $29 \times 10^6$ |
| Cast Iron | $12 \times 10^6$ | 18% Cr., 8% Ni. Steel | $29 \times 10^6$ |
| Wrought Iron | $28 \times 10^6$ | 25% Cr., 12% Ni. Steel | $29 \times 10^6$ |
| ½% Cr., ½% Mo. Steel | $29 \times 10^6$ | 25% Cr., 20% Ni. Steel | $29 \times 10^6$ |
| 1 to 1½% Cr., ½% Mo. Steel | $29 \times 10^6$ | Copper | $16 \times 10^6$ |
| 2¼% Cr., 1% Mo. Steel | $29 \times 10^6$ | Brass | $14 \times 10^6$ |
| | | Aluminum 28 | $10 \times 10^6$ |

# How to Buy Power Equipment and Materials Under Today's Controls

Last month (pp 76, 77), we took a quick look at the Controlled Materials Plan (CMP). Then, using a typical utility project as an example, we saw how Defense Electric Power Administration (DEPA) acts as *claimant agency* for electric utilities – giving priorities assistance and allotting controlled materials for "A" products and for direct use. Now let's see how the setup works for industrial and institutional power plants.

## SETUP DIFFERENT FOR NON-UTILITIES

**1 Where does DEPA come into the picture?**

If you plan an industrial or institutional power installation, you deal with DEPA only if the job involves an ac generator with a nameplate rating of 2000 kw or more. For such jobs you file a report with DEPA, using form DEPA-5A.

This permits DEPA to see if existing power systems might supply the load, making the installation unnecessary. It also gives DEPA the data needed to advise the National Production Authority (NPA) as to the essentiality and urgency of the proposed installation. NPA then directs-any-needed changes in manufacturers' schedules.

DEPA is *not* the claimant agency for such projects. Before trying to find who is, let's tackle another question.

**2 Do you need a claimant agency?**

There's nothing in the present controls scheme to prevent you from placing an order for, let's say, a boiler. If you do, the maker will undoubtedly give you a line on your chances for delivery, and tell you how to better them. For illustration though, let's suppose he doesn't. Your order is accepted and goes on his schedule.

Your boiler is a "B" product so the builder asks for a CMP allotment for its materials, along with the rest of his scheduled production. As things stand now, he'll only get some fraction of the materials requested. And he must use what he gets on *rated* (priority) orders first.

Your order isn't rated, so it gets pushed back on the schedule, either by the maker, or by NPA when they review schedule boards. Until the maker has enough materials allotted to cover both rated and non-rated orders, your job isn't going to move very fast.

The same thing is true for other "B" products you may need – fans, fabricated piping, controls, etc. Without a rating you may run into delays on any of them. A claimant agency can issue such a rating if your job deserves it.

**3 Where else does the claimant agency come in?**

On almost any job, you'll need some "A" products – duct-work, perhaps, or structural steel. Unless you find a fabricator who's in the black market, you'll not get what you need unless you can give an allotment for the controlled materials needed. And you'll be stymied again when you try to buy controlled materials to be used on the job by your contractor or your own force—reinforcing rod, plain pipe, instrument tubing, etc.

Looking at all the possible headaches, you'll want to find a claimant agency able to issue a rating for your job and give you an allotment of the controlled materials you need

**4 Which claimant agency is yours?**

List on facing page gives claimant agencies you're likely to be interested in, and an outline of the fields each covers. Dept of Agriculture, for example, is claimant for food-processing plants. That would be a good place to start if your plant serves a brewery, cannery, etc. Hospitals and similar institutions come under Federal Security Agency.

Each claimant agency listed scrutinizes projects in its field, issues ratings and CMP allotments to approved ones.

**5 How about industries not covered?**

Claimant agencies listed cover only a few fields. What happens, for example, if your power plant serves a paper mill? Or a chemical plant? Don't worry, you have the equivalent of a claimant agency in NPA.

NPA's many Industry Divisions are also listed. The direct job of these divisions is the processing of CMP allotments for production in their fields. They are not directly concerned with *expansion of production facilities*. NPA's Facilities Bureau is. But because the industry divisions know best the needs of companies in their fields, the Industrial Expansion Division of the Facilities Bureau turns to them for advice on issuing ratings and allotments.

So here's your rule: If none of the listed claimant agencies covers your industry, run down the NPA Industry Division list until you find the right one. Then take your problem to them and to the Industrial Expansion Division.

## HOW TO GET A RATING AND ALLOTMENT

**6 What are your chances for a rating?**

Much depends on what you need, why, and what industry you're in. Many defense-important chemicals, for example, are in short supply. If your power installation helps to boost output of a needed chemical, you've a good chance.

But suppose it aims to increase capacity of a soft-drink plant. You'll have a tough time, as things stand now, convincing anyone of urgent *national* need for such expansion.

**7 What's a good way to start the job?**

First take a hard look at your plans. Do you really need this installation now? Can it be justified from a national point of view, not just your own? If you can't come up with a firm "yes" to both questions, you'd better postpone the job. If you can, get organized to go after the rating and controlled-materials allotment you need.

**8 How should the job be organized?**

Set it up as a *complete* project, determining as closely as you can what you need in the way of equipment and controlled materials for "A" products and direct use. If you get project approval, you can "self-rate" the various items of equipment as you order them. Planning purchasing on a "single responsibility" basis as far as possible reduces paper work, lumps some "A" products into "B" items.

Also set, as closely as you can, the schedule for delivery

- **If you've got power equipment on order now, or plan to purchase, you'll be affected by current wider and stronger controls**
- **How well you make out depends to a large extent on how clearly you understand the system and work within its rules**
- **Here's your guide to controls on industrial and institutional power projects. Review last month's article for basic facts**

and erection of the various units. This schedule, along with equipment and materials lists, plus supporting plans and layouts, is the basic data you need to put before your claimant agency or NPA division.

**9 What about justifying your needs?**

Put down on paper the reasons why your power installation is needed. Remember, these are not reasons to convince your own management, but reasons that will have weight with men who must put the national interest first. Perhaps your company makes items needed for defense. Or, maybe, it has contracts to supply the armed forces. That, for example, might be a key point for the soft-drink plant mentioned before. And be sure to show exactly what effect your power installation will have on your company's production and any hardships resulting from lack of it.

**10 How do you present your case?**

When you've completed the above steps you're ready to seek the help of a claimant agency. If you're in doubt as to which is yours, or have other questions, check the NPA field office nearest you. They're in most large cities. Remember, also, that equipment suppliers are growing more familiar with control procedures, will be glad to help you.

Make your first approach to the claimant agency by letter, giving all pertinent information. Avoid going to Washington if you can — you'll save time for everybody.

Once your project has been submitted, keep following it. Right up to completion, keeping in touch helps.

**11 How about replacements, small jobs?**

There are some shortcuts for replacements, small jobs, maintenance items. See later articles.

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## PARTIAL LIST OF CLAIMANT AGENCIES

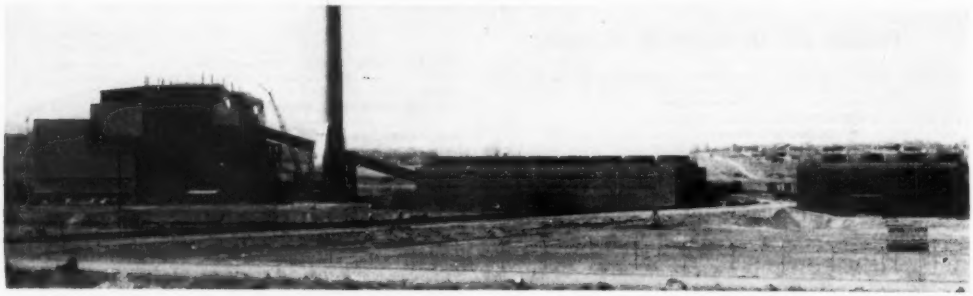
**FEDERAL SECURITY AGENCY:** Educational buildings (including integrated student and faculty housing), libraries, hospitals (except military and veterans), health facilities and services other than hospitals
**VETERANS ADMINISTRATION:** Hospital facilities for veterans
**DEPARTMENT OF AGRICULTURE:** Food processing and distribution
**DEFENSE SOLID FUELS ADMINISTRATION:** Coal mines, preparation plants and related facilities, coke-oven and coal-chemical facilities
**DEFENSE ELECTRIC POWER ADMINISTRATION:** Generating, transmission and distribution facilities of *electric utilities*
**DEFENSE MINERALS ADMINISTRATION:** Mines (except coal), nonferrous smelters
**PETROLEUM ADMINISTRATION FOR DEFENSE:** Oil and gas production; natural-gas processing and LPG distribution; gas transmission and distribution; gas manufacturing; oil and gas transportation (pipelines and terminals); oil refining; wholesale marketing
**DEFENSE TRANSPORT ADMINISTRATION:** Railroads, street and highway transportation, inland waterways, port facilities, storage (including refrigerated and dry-merchandise warehouses)
**OFFICE OF INTERNATIONAL TRADE:** CMP materials, exports to OIT areas
**ECONOMIC COOPERATION ADMINISTRATION:** Exports to ECA areas

## NPA INDUSTRY DIVISIONS

**AGRICULTURAL MACHINERY AND IMPLEMENTS:** Wheel tractors under 70 hp and parts, farm equipment, garden tractors, domestic water systems
**AIRCRAFT:** Civilian aircraft, engines, propellers and parts
**ALUMINUM AND MAGNESIUM:** Production of aluminum and magnesium
**BUILDING MATERIALS:** Wooden ladders; metal doors, sash, screens and weatherstrip; hardware; plumbing and heating fixtures, fittings, equipment and parts; ornamental metal work; metal prefab buildings and parts; house trailers; misc metal building products
**CHEMICALS:** Production of chemicals
**COMMUNICATIONS EQUIPMENT:** Telephone and telegraph equipment
**CONSTRUCTION AND MINING MACHINERY:** Wheel tractors 70 hp and over, track-laying tractors and parts, construction equipment, machinery
**CONSUMERS' DURABLE GOODS:** Household durable goods, commercial, institutional and professional furniture and fixtures, morticians' goods, batteries and bulbs, misc consumers' durable goods
**CONTAINER AND PACKAGING:** Wood, paper and fiber containers; metal cans, barrels and drums; collapsible tubes; metal caps
**COPPER:** Production materials for melting industry and wire mills
**ELECTRICAL EQUIPMENT:** Lighting fixtures, wiring devices and line hardware, electrodes and brushes, motors and generators, transformers and rectifiers, control equipment, storage batteries
**ELECTRONICS:** Tubes, electronics equipment and parts
**ENGINE AND TURBINE:** Heavy metal tanks, power boilers and parts, steam engines and turbines, internal-combustion engines (except aircraft and automotive), heat exchangers and steam condensers, generators and motor-generator sets, fabricated piping, deserating heaters, water softeners
**GENERAL COMPONENTS:** Hand and edged tools; bearings and bushings; bolts, nuts and other fasteners; mechanical-power-transmission equipment, valves, gaskets, wire cloth and chain
**GENERAL INDUSTRIAL EQUIPMENT:** Abrasive products, machine tools and accessories, power-driven hand tools, special-purpose industrial machinery, materials-handling equipment and accessories, fans and blowers, scales and balances, compressors and pumps, refrigeration and air-conditioning equipment, welding equipment, rods, electrodes
**IRON AND STEEL:** Production materials for iron and steel industry
**LEATHER AND LEATHER PRODUCTS:** Leather garments; luggage, handbags, etc; mechanical and leather belting; lasts and shoe findings
**LUMBER AND LUMBER PRODUCTS:** Logging and lumber operations; production of veneer, plywood and other wood products
**METAL-WORKING MACHINERY AND EQUIPMENT:** Production of these items
**MINING MACHINERY:** Mining equipment, machinery and parts
**MISC METALS AND MINERALS:** Not specifically designated elsewhere
**MOTION PICTURE, PHOTOGRAPHIC PRODUCTS:** Lenses, equipment, supplies
**MOTOR VEHICLE:** Passenger cars, parts, components, accessories; trucks, tractors, trailers, parts; automotive maintenance equipment
**ORDNANCE AND SHIPBUILDING:** Civilian arms, ammunition and blasting accessories; civilian boats and ships
**PRINTING AND PUBLISHING:** Production of blank books and loose-leaf binders, other printing and publishing operations
**PULP, PAPER AND PAPERBOARD:** Production of wood pulp, paper, paperboard, of paper and paperboard products; collection of waste paper
**RAILROAD EQUIPMENT:** Frogs, switches, railway signal equipment, locomotives and parts, railroad cars and parts, rapid-transit cars, parts
**RUBBER:** Production of rubber and rubber products
**SCIENTIFIC AND TECHNICAL EQUIPMENT:** Fire equipment and apparatus; medical, dental, surgical and optical equipment; laboratory and scientific equipment and instruments; watches, clocks and parts; testing, regulating, integrating and related technical equipment; aircraft and nautical instruments; alarm and signal systems
**SERVICE EQUIPMENT:** Office and store machines; coin-operated and amusement machines; commercial laundry, dry-cleaning and related equipment; service trades equipment
**TEXTILE:** Production of textiles
**TIN, LEAD AND ZINC:** Production of these metals
**WATER AND SEWERAGE:** Construction, equipment and supplies

**CANADIAN DIVISION:** CMP materials and other exports for Canada
**OFFICE OF CIVILIAN REQUIREMENTS:** Federal, state and local governments; wholesale, retail and service trades not specifically designated elsewhere; religious institutions; consumer goods, including items and equipment in common use but not specifically designated elsewhere
**FACILITIES BUREAU:** Construction of: state as well as local community facilities not specifically designated elsewhere, such as fire and police stations, penal institutions, administrative buildings; facilities for wholesale, retail and service trades not specifically designated elsewhere; religious and institutional facilities; private industrial facilities; other private facilities

**OUTDOOR STEAM GENERATORS** for first two units share common stack. From upper housing the vertical, tubular air heaters extend downward to inlets of mechanical dust collectors. Two induced-draft fans on each boiler force gas into stack base



**SEMI-ARID CLIMATE** limits river flow most of year, leads to using cooling towers for Arapahoe. First two units have 8 tower sections, *at center;* 4 sections, *at right,* for Unit No. 3. Turbines and auxiliaries are completely housed in the building, *at left*

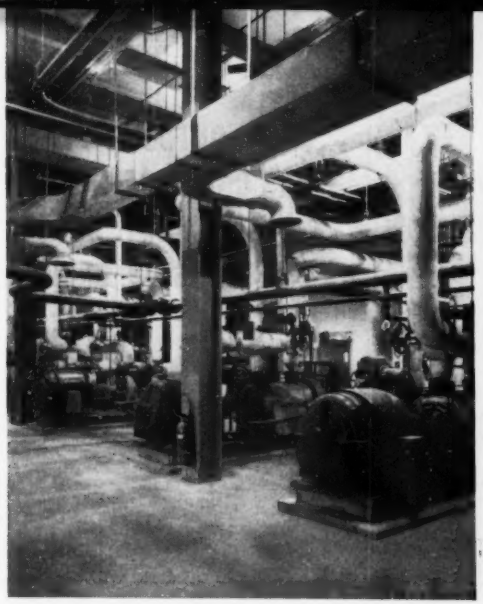
# ARAPAHOE: Mile-High Central Station

**Semi-outdoor plant eliminates sub-basement excavation, places boiler feed pumps, mills, draft fans and compressors on ground level to minimize installation costs. Steam generators burn subbituminous coal and natural gas, separately or combined**

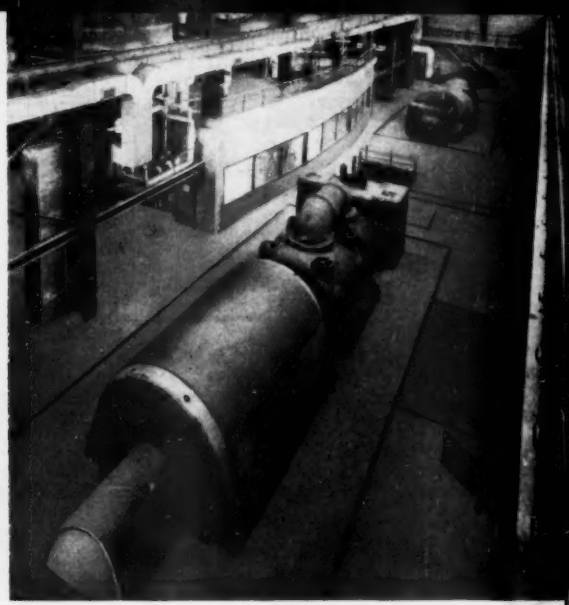
By **R F THRONE,** *Supt Steam Production, Public Service Co of Colorado* and **P E GOURDON,** *Chief Mechanical Engr, Ebasco Services Incorporated*

► SINCE THE START of World War II the Rocky Mountain Area has grown rapidly in population and industrial capacity. Colorado and especially Denver, largest population center of the area, are the leading examples of this trend. Early in 1947, Public Service Co of Colorado, serving Colorado and Denver, decided to expand its facilities with a new steam-electric station.

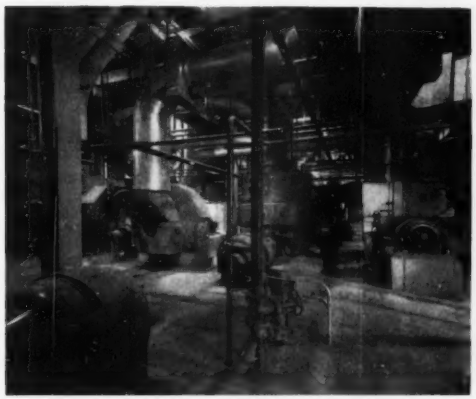
A site on South Platte River, on the southern Denver city limits, has area for future expansion, adequate coal storage, makeup to supply cooling towers. River flow is not large enough to



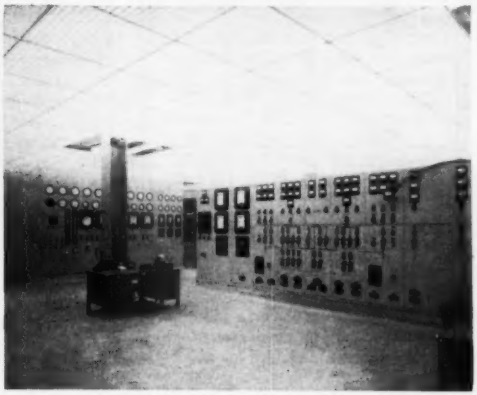
**THREE BOILER FEED PUMPS** for each unit use motor drive. Two pumps can carry full load, third stands by for emergency



**UNITS NO. 1 AND 2** are both preferred-standard 40,000-kw turbines. Control room, *left*, supervises boilers, turbines



**FOUR PULVERIZERS** for Unit No. 1 are arranged as corners in rectangle on ground floor, feed 450,000-lb-per-hr boiler



**CENTRAL CONTROL ROOM** houses electrical control panel, *center*, turbine control panel, *left*, boiler controls not shown

support a once-through cooling system for Arapahoe Station. Though present design contemplates maximum capacity of 200,000 kw, the site can accommodate about 300,000 kw.

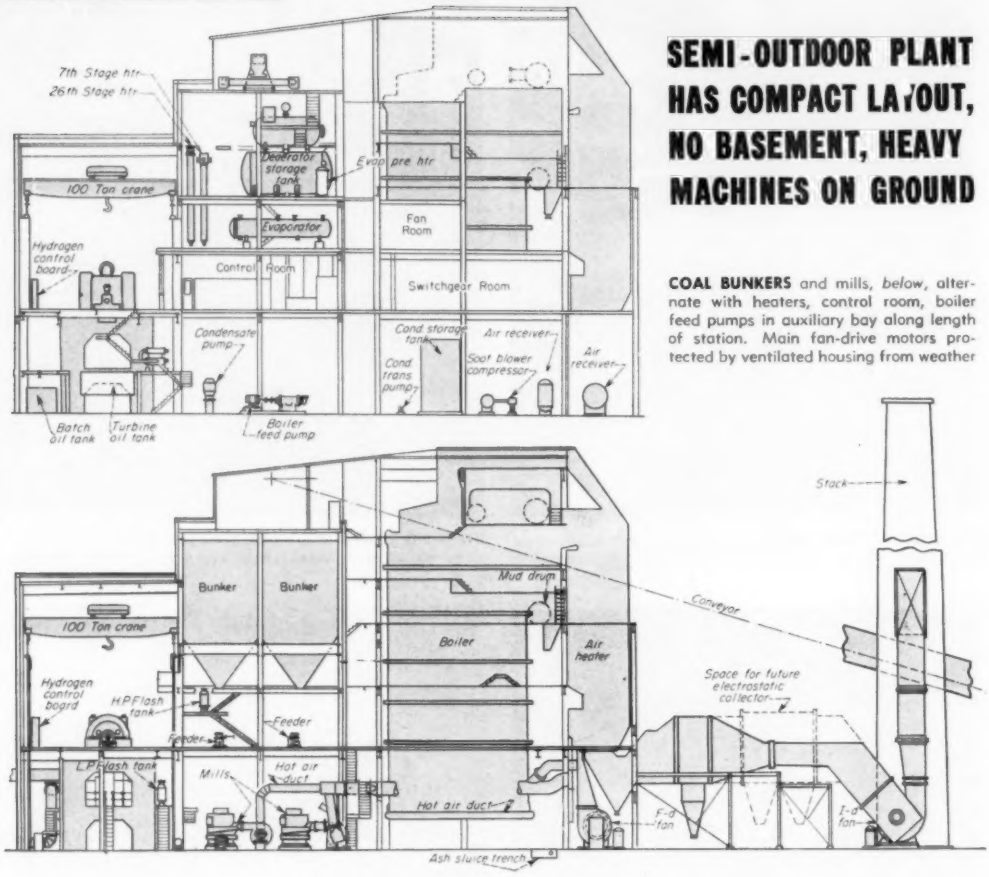
Early in 1948 design work started on two 40,000-kw preferred-standard units to be served by single boilers with no cross-connection. Initial steam conditions of 850 psig and 900 F were chosen because most of the year low-cost natural gas will be available. High-moisture sub-bituminous coal will supplement it.

Unit No. 1 went on the line Oct 7, 1950, No. 2 on March 16, 1951, No. 3 is now under construction. This third unit, same as No. 1, will run late in 1951.

**Station layout** features compactness and economy. Outdoor-type steam generators have only upper area around drum and burners housed. Building has brick front on south and east walls for architectural appearance, insulated steel panels for other walls. Placing all heavy rotating equipment, like boiler feed pumps, mills, draft fans on the ground level, held down structural-steel costs. Eliminating a sub-basement reduced excavation and foundation costs.

Location of the central control room for first two units minimizes length of conduit and control-piping runs to boilers and turbines. Each pair of units will have individual control rooms. Only the two bunker bays separate the boilers from the turbines. Deaerators, heaters and evaporators for two units stand above the control room. This eliminates the usual auxiliary bay. A 100-ton turbine-room crane can handle larger future unit parts.

**Performance.** Straight regenerative heat cycle uses 5 bleed points. The top three heaters, of vertical 2-pass design,




# SEMI-OUTDOOR PLANT HAS COMPACT LAYOUT, NO BASEMENT, HEAVY MACHINES ON GROUND

**COAL BUNKERS** and mills, *below*, alternate with heaters, control room, boiler feed pumps in auxiliary bay along length of station. Main fan-drive motors protected by ventilated housing from weather

have no integral drain coolers. Lowest-stage heater mounts in condenser neck to conserve space and reduce length of large bleed piping. With 865-psig 900-F throttle steam and 2.5-in. Hg exhaust, the first two units are expected to run with a net heat rate of 12,220 Btu per kwhr at 44,000-kw load. Predicted boiler efficiency equals 86% and auxiliary demand about 6.5% at this output.

**Steam generators** are vertically fired through the roof tubes with either or both natural gas and pulverized Colorado sub-bituminous coal. Considerable experience with pulverized high-moisture sub-bituminous coal has proven this to be satisfactory because of the fuel's long-flame characteristics. Conservative heat release of only 13,500 Btu per cu ft per hr at rated output features the boiler design.

Four ball-type mills, 16,800-lb-per-hr capacity each, pulverize coal for Unit No. 1. Four bowl-type mills, 20,700-lb-per-hr capacity each, serve No. 2.

Each boiler has a completely automatic, sequential, air soot-blowing system. These consist of four long retractable blowers, 18 rotary air puff blowers, and two straight-line blowers for the tubular air heater. Air comes from two 504-cfm compressors delivering to a primary receiver at 500 lb. An outdoor receiver saves building space.

Tubular air heaters are built in two sections. The bottom section has heavy-wall short tubes that can be easily replaced if they corrode. A recirculating duct from air-heater outlet to forced-draft fan inlet inhibits moisture in the air heater to some extent. Each boiler has two forced-draft and two induced-draft fans driven by constant speed motors and controlled by inlet vanes and outlet dampers. Because of expected high load factor operation, variable-speed couplings were not installed.

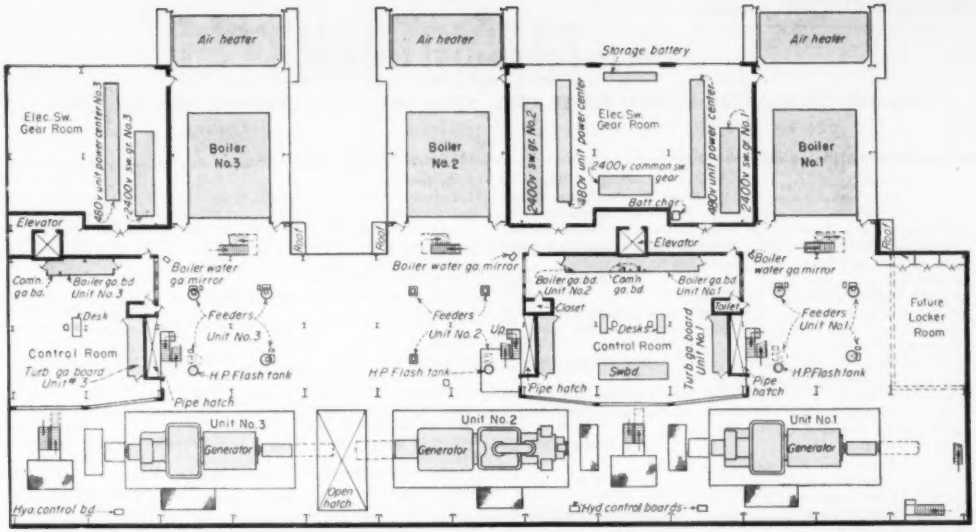
**Auxiliaries.** Two vertical pit-type condensate pumps in the ground-level slab take water from condenser hotwells.

The three boiler feedwater pumps per unit can each carry 60% of rated boiler output. These double-case balanced-impeller pumps have automatic recirculation control for low-load protection.

The completely automatic combustion-control system has air-operated control drives specially designed for outdoor installation. Two double-acting air compressors supply control air through a silica-gel air dryer. This reduces the dewpoint to −40 F, preventing freezing up of outdoor control equipment during winter operation.

**Circulating Water.** Double-flow induced-draft cooling towers have 2-speed reversible fans, which permit de-icing cells during the winter. Two wells at the bank of the South Platte River supply makeup to the towers. The makeup first flows through the plant auxiliary coolers before entering the cooling-water system.

One pump on each unit passes water from the tower basin through the con-




**OPERATING FLOOR PLAN** shows control room centered between main boilers, turbines and auxiliaries for each two units. Corresponding switchgear rooms stand between outdoor boilers with miscellaneous station auxiliaries on ground slab below *(p 104)*

denser and over the tower. Vertical axial-flow pumps stand in a separate building, also housing water-treating facilities and centralized automatic well controls. Circulating water flows through cast-in-place concrete tunnels, common to all units. Tunnels and pump house are sized for a 4-unit plant. Space is available for tunnels for a 5th and 6th unit.

Circulating-water treating facilities include complete automatic chlorination on an intermittent cycle and automatic pH control utilizing commercial sulfuric acid. Proportioning pumps, with stroke adjustment by a pH controller, handle the acid. Special precautions insure safety in handling chemicals. Chlorinator, acid control, proportioning pumps and chlorine storage stand in separate rooms. The 10,000-gal acid-storage tank stands outside the pump house adjacent to the railroad siding. An air unloading system transports acid from cars to tank.

**Coal Handling.** Present system was laid out for a 4-unit plant using a 2-track 3-hopper unloading pit initially equipped with two apron feeders and two reciprocating plate feeders. A belt feeds coal from track hopper to a crusher and transfer house. Here coal is crushed and screened for belt conveying to the building or, uncrushed, to storage. The belt feeding coal to the plant discharges onto a traveling shuttle conveyor equipped with two airplane-type conveyors on either end for bunker filling. The 300-ton capacity can be raised to 600 ton per hr by speeding up all conveyors and adding a section to the crusher house. If 5th and 6th units are added a new crusher house will be added west of the present house with duplicate equipment.

Space is available for a car shakeout, car dumper and track scales. Complete interlocking of the coal-handling system prevents damage to equipment and danger to operators.

**Ash Handling.** Hydraulic jet pumps move ashes from the wet-type ashpit of each boiler to an abandoned gravel pit on the plant site. This pit will receive ashes for some years before they must be removed by car. A vacuum system removes flyash from the hoppers. High-pressure water nozzles create the vacuum. The system includes a stack hopper and intake for automatic removal of stack dust. Two vertical high-pressure water pumps pick up sluicing water from the gravel pit. A causeway separates the water intake from the ash-disposal area to prevent clogging pumps with silt and ash.

**Electrical System.** All power output flows through a main transformer bank in each unit to a 110-kv bus supplying four transmission lines. Each transformer bank has three single-phase 13.2-kv delta 63.51/110-kv solidly grounded wye transformers. Combined continuous forced-air-cooled rating is 124,998 kva for the two units.

Each generator has a direct-connected exciter, with no standby source of excitation. Indirect-acting voltage regulators, with line-drop compensation, automatically control generator voltage. Main generators are not tied together directly. High side of each main transformer bank connects to the others. The system includes automatic frequency- and load-control equipment.

**Auxiliary Power.** With minor exceptions, the electrical system supplies all auxiliary power. Each unit has a 6000-kva 13,200/2400-v 3-phase delta-delta transformer connected directly to generator leads for auxiliary supply. The primary of a "startup" or standby 6000-kva transformer connects to the 13-kv Denver network. In the failure of any unit-auxiliary transformer, the operator can place the standby transformer in service by manual control.

Auxiliary motors of 250 hp and above connect to the 2400-v switchgear. Largest motors, 800 hp, drive the circulating pumps. The 480-v switchgear and control centers supply all other motors.

In addition to the 6000-kva transformers, there are four 1000-kva station-service, one 500-kva coal-handling, and two 500-kva cooling-tower transformers. They are all 2400/480-v 3-phase delta-delta connected, fed from the 2400-v switchgear units.

The 6000-kva transformers are oil-insulated self-cooled, and mounted outside the building wall. The 2400-v secondary of each transformer connects to the 2400-v switchgear units by metal-enclosed insulated nonsegregated non-isolated phase bus having basic impulse

## PRINCIPAL POWER-PLANT EQUIPMENT

### ARAPAHOE STEAM ELECTRIC STATION; DENVER, COLO., PUBLIC SERVICE CO OF COLORADO, UNITS NO. 1 AND 2

#### *STEAM-GENERATING EQUIPMENT:*

Steam generators, 2 ..... Babcock & Wilcox Co
3-drum special Stirling type, 450,000 lb per hr continuous, 480,000 lb per hr maximum, 925 psig, 905 F. Pulverized high-moisture subbituminous coal and natural gas fired. Down-fired intertube burners. 41,900-cu-ft furnace, 7794-sq-ft projected waterwall, 19,800-sq-ft superheater, 13,500 Btu per cu ft per hr max furnace heat release

Air heaters, 2 ..... Babcock & Wilcox Co
Vertical, tubular, 2 sections, 118,370 sq ft

Forced-draft fans, 4 ..... Sturtevant Div, Westinghouse Elec Corp
100,000 cfm, 13.8 in. water static head, direct coupled, inlet vane and outlet damper controlled

F-d fan drives, 4 ..... Allis-Chalmers Mfg Co
300 hp, 1200 rpm, 2300 v, 3 phase, 60 cycle

Induced-draft fans, 4 ..... Sturtevant Div, Westinghouse Elec Corp
173,500 cfm, 12.8 in. water static head, direct coupled, inlet vane and outlet damper controlled

I-d fan drives ..... Allis-Chalmers Mfg Co
700 hp, 800 rpm, 2300 v, 3 phase, 60 cycle

Coal feeders (Unit No. 1), 4 ..... Babcock & Wilcox Co
Table type, two speeds with gate control

Coal mills (Unit No. 1), 4 ..... Babcock & Wilcox Co
Ball type, 16,800 lb per hr capacity

Primary air fans (Unit No. 1), 4 ..... Clarage Fan Co

Coal-mill drives (Unit No. 1), 4 ..... Allis-Chalmers Mfg Co
100 hp, 600 rpm, 440 v, 3 phase, 60 cycle

Primary air fan drives (Unit No. 1), 4 ..... Allis-Chalmers Mfg Co
125 hp, 1800 rpm, 440 v, 3 phase, 60 cycle

Coal feeders (Unit No. 2), 4 ..... Combustion Engrg-Superheater Inc
Star type, variable-speed drive

Coal mills (Unit No. 2), 4 ..... Combustion Engrg-Superheater Inc
Bowl type, 20,700-lb-per-hr capability

Exhausters, 4 ..... Combustion Engrg-Superheater, Inc

Mill and exhauster drives ..... Allis-Chalmers Mfg Co
250 hp, 1200 rpm, 2300 v, 3 phase, 60 cycle

Water columns, bi-color, 4 ..... Diamond Power Specialty Corp

Safety valves, 8 ..... Manning, Maxwell & Moore

Soot blowers ..... Diamond Power Specialty Corp
8 retractable, 36 air puff, 4 straight line, 500-psig primary air press.

#### *POWER-GENERATING EQUIPMENT:*

Turbine-generator, Unit No. 1 ..... General Electric Co
40/44-mw preferred-standard, 850 psig, 900 F, 3600 rpm, hydrogen-cooled generator, shaft-mounted exciter

Turbine-generator, Unit No. 2 ..... Westinghouse Elec Corp
40/44-mw preferred standard, 850 psig, 900 F, 3600 rpm, hydrogen-cooled generator, shaft-mounted exciter

Condenser, Unit No. 1 ..... Allis-Chalmers Mfg Co
30,000 sq ft, 2-pass, divided waterbox, phosphorized admiralty tubes

Condenser, Unit No. 2 ..... Westinghouse Elec Corp
30,000 sq ft, 2-pass, divided waterbox, phosphorized admiralty tubes

Steam-jet air pump, Unit No. 1 ..... Allis-Chalmers Mfg Co
Two-stage, 350-psig steam pressure

Steam-jet air pump, Unit No. 2 ..... Westinghouse Elec Corp
Two-stage, 350-psig steam pressure

Circulating water pumps, 2 ..... Allis-Chalmers Mfg Co
31,000 gpm vertical axial flow, 800-hp, 600 rpm 2300-v motor drives

Condensate pumps, Unit No. 1; 2 ..... Allis-Chalmers Mfg Co
700 gpm, 350-ft head, vertical pit-type, 100-hp 1800-rpm 440-v 3-phase 60-cycle motor drives

Condensate pumps, Unit No. 2; 2 ..... Westinghouse Elec Corp
700 gpm, 350-ft head, vertical pit-type, 100-hp 1800-rpm 440-v 3-phase 60-cycle motors

Chlorination equipment ..... Wallace & Tiernan Products Inc
Automatic intermittent desliming

Acid feed, automatic pH control ..... Permutit Co

#### *FEEDWATER EQUIPMENT:*

Boiler feed pumps, 6 ..... Byron Jackson Co
Horizontal double case, 265,000 lb per hr, 1160 psig, 290 F

Boiler-feed-pump drives, 6 ..... Allis-Chalmers Manufacturing Co
Induction motors, 600 hp, 3600 rpm, 2300 v, 3 phase, 60 cycle

High-pressure heaters, 4 ..... Struthers Wells Corp
Vertical, 2-pass, 5/8-in. cupro-nickel tubes

Intermediate-pressure heaters, 2 ..... Struthers Wells Corp
Vertical, 2-pass, 5/8-in. arsenical copper tubes

Low-pressure heaters, 2 ..... Struthers Wells Corp
Horizontal, 2-pass, 5/8-in. arsenical copper tubes, installed in condenser necks

Deaerating heater, 2 ..... Worthington Pump & Mach Corp
Horizontal, 400,000-lb-per-hr capability at 0.005 cc oxygen content with horizontal 125,000-lb storage tank

Feedwater control, 3 element ..... Bailey Meter Co

Softeners, 2 ..... Permutit Co

Evaporator preheaters, 2 ..... Worthington Pump & Mach Corp

Evaporators, 2 ..... Griscom-Russel Co
13,500-lb-per-hr net vapor output, horizontal, bent tube

Condensate storage tanks, 2 ..... Eaton Metal Products Corp
11,000 gal each, vertical

#### *COAL- AND ASH-HANDLING SYSTEMS:*

Coal crusher, 300 ton ..... Pennsylvania Crusher Co

Magnetic pulley ..... Stearns Magnetic Mfg Co

Weightometer ..... Merrick Scale Manufacturing Co

Belt conveyors ..... Webster Manufacturing Co
300 ton per hr, three 36-in., one 42-in., 2 plate feeders, 2 apron feeders, one traveling shuttle with two 36-in. wing belts

Mechanical precipitators, 2 ..... Aerotec Corp

Dust-handling system ..... United Conveyor Corp
Hydrovac, 15 tph, automatic control of collector hoppers

Bottom ash-handling system ..... United Conveyor Corp
Wet hopper, jet-pulsion pump, 25 tph

#### *ELECTRICAL EQUIPMENT:*

Exciter, 1 ..... General Electric Co
145 kw, 250 v, direct connected

Exciter, 1 ..... Westinghouse Elec Corp
155 kw, 250 v, direct connected

Generator transformers, 2 banks ..... General Electric Co; Westinghouse Elec Corp

Unit auxiliary power transformer, 1 ..... General Electric Co

Unit auxiliary power transformers, 2 ..... Westinghouse Elec Corp

Station service transformers, 4 ..... Westinghouse Elec Corp
2400/480 v, 3 phase, 1000 kva self-cooled dry type, 7.5% imp

Coal-handling transformer, 1 ..... Westinghouse Elec Corp
2400/480 v, 3 phase, 500 kva, 5% impedance

Oil circuit breakers, 115 kv ..... Westinghouse Elec Corp

#### *MISCELLANEOUS:*

Soot blower compressors, 2 ..... Worthington Pump & Mach Corp
504 cfm, 500 psig, two-stage, horizontal

Compressor drives, 2 ..... Allis-Chalmers Mfg Co
150-hp 300-rpm synchronous motors

Control-air compressors, 2 ..... Gardner-Denver Co
150 cfm, 90 psig, single-stage double-acting

Station air compressor ..... Gardner-Denver Co
250 cfm, 100 psig, six-stage, double-acting

Combustion control system ..... Bailey Meter Co

Gage boards ..... Bailey Meter Co

Turbine room crane, 100-ton main hook, 10-ton auxiliary ..... Shaw Box Crane & Hoist Div, Manning, Maxwell & Moore

Miscellaneous pumps ..... Worthington Pump & Machinery Corp

Automatic boiler feed pump bypass ..... Republic Flow Meters Co

ENGINEERS AND CONSTRUCTORS ..... Ebasco Services Incorporated

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level of 60 kv. The switchgear mounts inside the building in the central switchgear room. Bus-tie connections between 2400-v units consist of the same type bus. Switchgear is of the drawout type.

The dry-type 1000-kva transformers in the switchgear room close-couple with the 480-v drawout switchgear. The 500-kva transformers are oil insulated, self-cooled, and outdoor type. They are throat connected to their respective motor control centers.

A system of open cable trays or troughs stands under the control-room and switchgear-room floors. The trays carrying control cables are reached by adjacent access platforms for testing and maintenance purposes.

# DEFENSE DIGEST

*Your roundup of mobilization news and trends affecting power men*

REHEARSAL FOR A POWER SHORTAGE . . .

is what the Pacific Northwest situation turned out to be when timely rains eased it out of the crisis stage. Defense Electric Power Administration was all set to put curtailment measures into effect. DEPA may find experience useful later, either in the Northwest (still tightest area) or in the Southeast, where the going is also nip and tuck. Some cities may face curtailments this winter.

Tightness in some areas was expected (POWER, Aug, p 103) but two things are making the going tougher: generally greater load pickup than estimated, and delays in getting new capacity on the line (traceable mostly to short materials).

ON THE METALS FRONT . . .

little encouragement can be found. Lead shortage has become so acute, makers of bearings say it should be included with steel, copper and aluminum as a controlled material. New international copper agreement isn't expected to bring much relief, now or later. With new sources slow in developing, copper promises to be shortest of widely used metals for some time to come. Work stoppages this summer cost 30,000 tons of copper; we had to dig into the stockpile for 25,000.

James Fairman, DEPA Administrator, highlights need for steel scrap in his Industry Letter No. 24. He asks top-level attention to freeing idle and obsolete machines, reconsideration of inventory and reserve policies. New issue of List of Basic Materials and Alternates has been published by National Production Authority (Washington 25, D.C.), to keep industry abreast of changes in supply of critical materials and their substitutes.

POWER UNLIMITED . . .

or almost unlimited, is what the electrical manufacturing industry is betting on: Westinghouse to the tune of $300 million to double output by 1955, GE with about $450 million for expansion in next three or four years.

Kind of figures on which these expansion plans rest were highlighted recently by GE's Chester Lang. He pointed out that American industry uses almost 7 kwhr per manhour, predicted a rise to 10. Before 1970, Lang forecast, industry will use a trillion kwhr per year, more than triple amount now used in U.S.

SCHEDULING INDUSTRIAL EXPANSION . . .

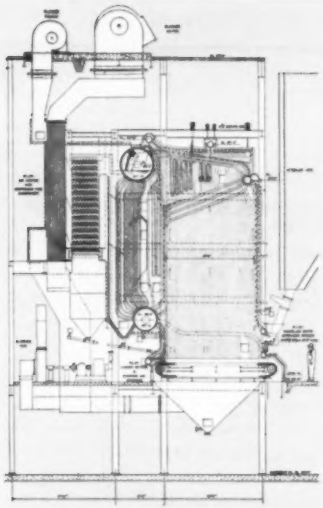
is counted on to untangle snarl caused by acute shortage of structural steel. Scheduling won't produce any steel but it will help make what is available go further. Defense Production Authority has begun to check industrial expansion plans, evaluate urgency of each. For some programs – steel, aluminum, oil refining, electric power, railroad equipment and natural gas – it has already added up the plant to be built, figured cost in materials. (In electric power, DPA may delay some new starts; copper to equip plants may not be available by time it's needed under present schedules.)

While DPA readies schedules, structural steel and other materials for plant expansion are parceled by rule of thumb: military, atomic energy and aluminum expansion get 100% of needs. So does basic steel, but not steel-finishing plant. Beyond this, materials go to plants already under construction.

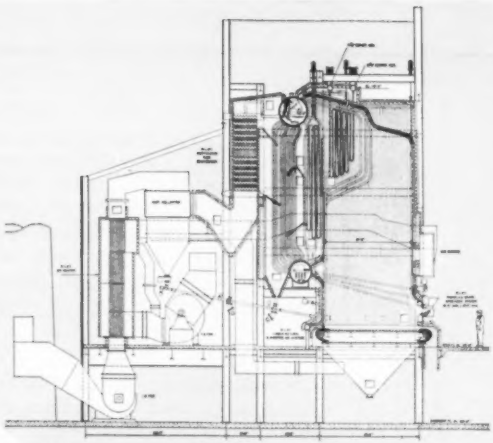
REVIEWING POWER REQUIREMENTS . . .

and advising on expansion plans is the assignment given a new committee by DPA Administrator Manly Fleischmann. Under chairmanship of E. W. Morehouse, VP, General Public Utilities Corp, NYC, committee will work with DEPA and DPA's Office of Program and Requirements.

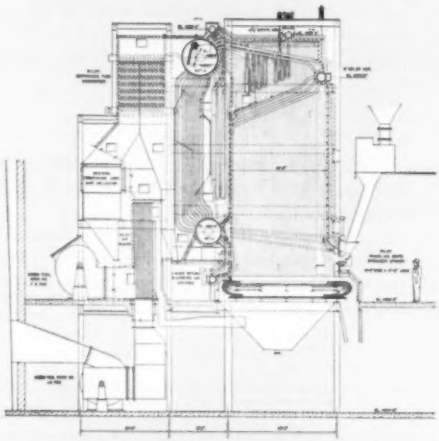
# A few outstanding Spreader-Stoker



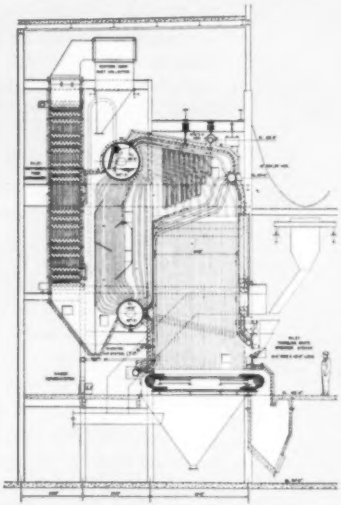
CARBIDE & CARBON CHEM. CORP., Whiting, Ind.
Three 165,000 lbs./hr. 1000 psig 790°F.



CORN BELT POWER CO-OPERATIVE, Humboldt, Iowa
125,000 lbs./hr. 700 psig 825°F.



THE CLIFFS POWER & LIGHT CO., Ispheming, Mich.
100,000 lbs./hr. 450 psig 750°F.



IOWA-ILLINOIS GAS & ELECTRIC CO., Iowa City, Iowa
60,000 lbs/hr. 500 psig 740°F.

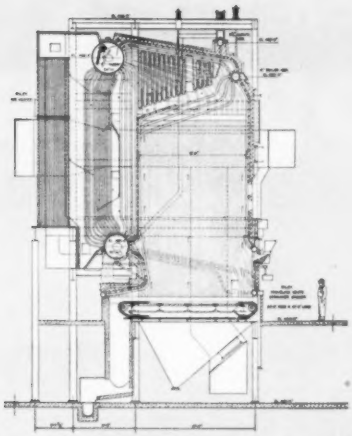
# RILEY

## STOKER CORPORATION, WORCESTER, MASS.

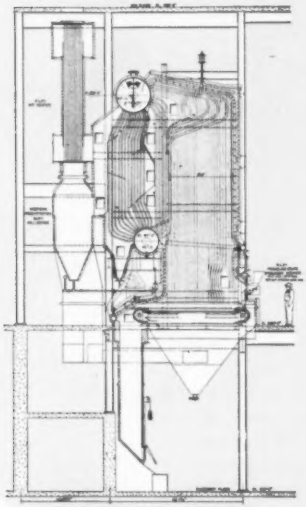
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston Denver
Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

# fired RILEY Steam Generating Units



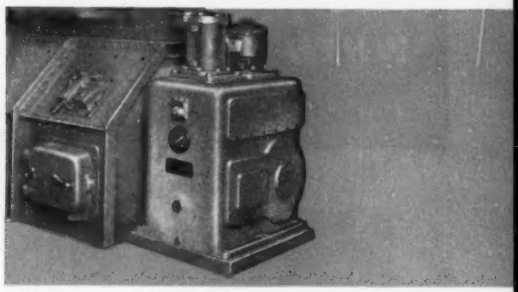
EUGENE WATER & ELECTRIC BOARD, Eugene, Ore.
175,000 lbs./hr. 700 psig 835°F.
Waste wood is also burned.



OHIO EDISON CO., Akron, Ohio
90,000 lbs./hr. 250 psig

**Compare the Construction of these Important Parts . . .**

**Grate Drive**

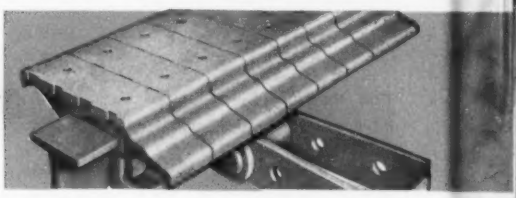


Riley uses a hydraulically driven ratchet drive, completely enclosed and automatically lubricated. This simple rugged drive operates with practically no maintenance and is not susceptible to damage in case of grate obstruction. No sprockets, chains or speed reducers are required.

**Feeder Distributor**

The use of an adaptation of the Stephenson link mechanism provides complete speed control. The entire mechanism is enclosed and splash lubricated. The overthrowing distributor gives uniform longitudinal and lateral distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing.

**Grate Surface**



The grate surface is made up of small grates, only 2 inches wide by 6-inch pitch, mounted on carrier bars. The use of small grates assures low maintenance and long life by providing adequate cooling and the elimination of warping and cracking. Uniform air distribution is obtained.

*A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs*

# COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

# Keep your eye on V·P·I

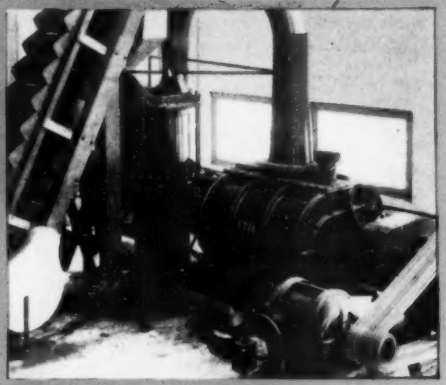
## WHEN SELECTING BLOWERS

CENTRIFUGAL

Motor-driven Type O1B Centrifugal Blower in chemical processing plant. Capacity 19,000 cfm.

Wet bark is blown 400 feet, from charger to stoker, by R-C Rotary Positive Blower in this Nova Scotia paper mill.

ROTARY



You can't afford to risk shutdowns today because of unsatisfactory or inadequate equipment performance. To keep production moving at the required fast pace, calls for blowers or gas pumps that continuously deliver positive Volume at required Pressure—and at Low power costs to reduce operating expense.

You get these 3 essentials from R-C Blowers and Gas Pumps. Whether your needs call for Centrifugal or Rotary Positive units, we can match them from our exclusive *dual-ability line*. With capacities from 5 cfm to 100,000 cfm, you can usually find R-C units that closely fit your demands, with resultant savings in time, cost, space, weight and power.

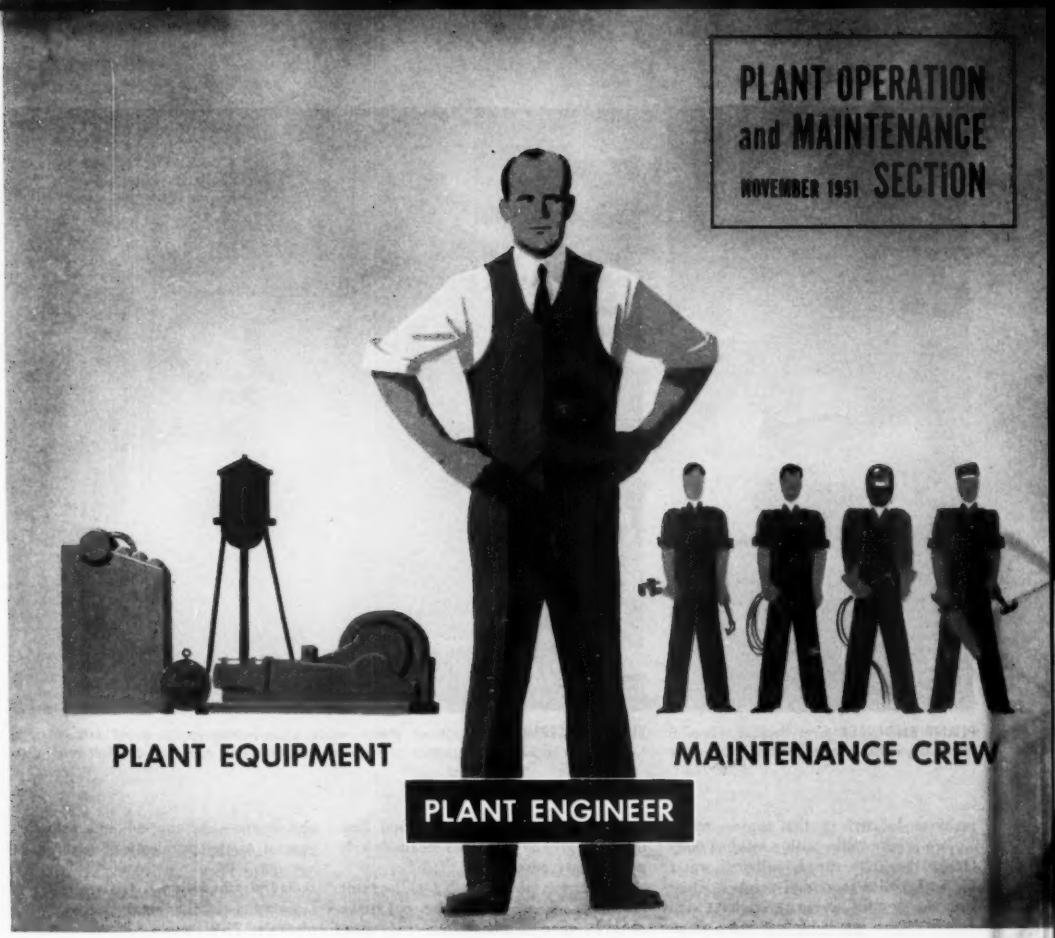
From an experience of almost a century of blower building, our engineers will gladly make suggestions of the right R-C equipment to move or measure gas and air to keep production going.

ROOTS-CONNERSVILLE BLOWER CORPORATION, 510 Powell Avenue, Connersville, Indiana.

**ROOTS-CONNERSVILLE**

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES




# Keeping on Top of Plant Operation

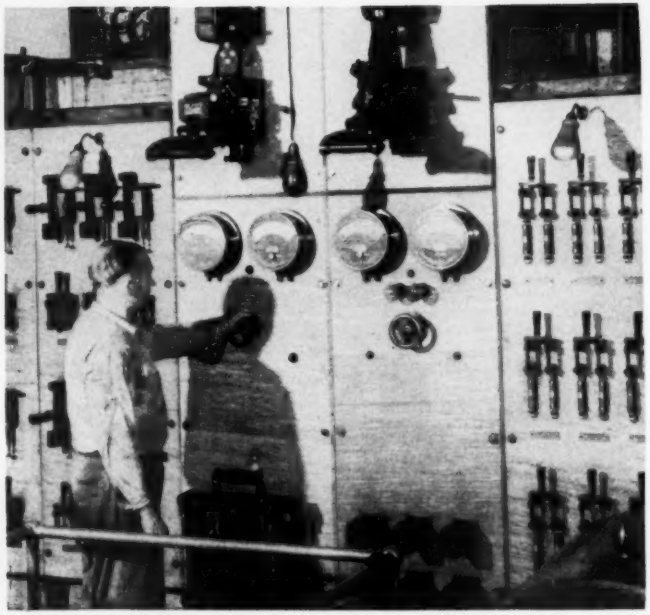
***Good engineering, sound scheduling and a long-range preventive maintenance program make it possible for a plant engineer to meet production under all conditions. Here's how the pieces fit together***

► THE LOT of a plant engineer has never been a bed of roses. If he's real close to operation, he probably grew up as an operating man. And that's pretty much his first love. Yet with the spread of power services in the average industrial plant he has to become a manager just to keep on top of his job.

What are the tools he can use? And how do they fit in? Good engineering, sound scheduling and long-range preventive maintenance are the principal aids in keeping a plant running smooth. Just how big a part each plays depends on the skill of your operating crew and how good your records are.

The North American Lace Co plant in Philadelphia gives a good idea of the job at hand and some worthwhile tips on running it. They've got a full-scale boiler room with two brand new 20,000-lb-per-hr spreader-stoker-fired boilers, plus an older, single-retort underfeed stoker-fired unit, also of about 20,000-lb-per-hr capacity. In addition, there's about 1000 kw of electric-generating capacity made up of steam engine and

**PLANT ENGINEER** G H Perkins, Chief E H Nace give equipment records going-over



**ELECTRIC SERVICE** throughout plant needs close watching to avoid circuit overloads, unscheduled interruptions; requires engine-room operator on full-time duty

turbines located in the engine room.

Two zeolite tanks with a total of 600,000-gal capacity supply softened water for both boiler room and process. Over 500 dc motors work throughout the plant. When you add to them a compressed-air system for mill machine controls, sprinklers for fire protection, fans and blowers for mill exhaust and ventilation, you see the sizable equipment investment the plant engineering department has to ride herd on.

**Good Engineering.** Supplying the power services with as little interruption as possible depends largely on how well engineered the services are. Take the steam supply. A few years back the company recognized a need for new steaming capacity. But before they picked out a boiler they considered every factor. Fuel was one that figured heavily in their decision. The plant had been running a number of years and the surrounding area was well built up.

So available space and influence of a fairly tough Philadelphia air-pollution ordinance had to enter into the selection of fuel and firing method. By themselves they may have indicated a selection somewhat different from the actual one. Overriding the space- and smoke-law considerations were the demands of good engineering for mill needs—a boiler installation with good fuel flexibility to give as assured a steam supply as humanly possible.

Result was the two 20,000-lb-per-hr spreader stokers. During the coal strike of 1949 they demonstrated their flexibility by successfully firing a wide variety of coals and keeping an uninterrupted steam flow. The city of Philadelphia air-pollution control department singles this plant out as a good example of how a plant within the city limits can operate without creating an air-pollution nuisance.

Another example of engineering that gives longer operating life to mill equipment with less maintenance is the water-softening system. All water is purchased and, in keeping with most city-water supplies, is clear, of moderate-sodium content, near-neutral and with a relatively low alkalinity. With such a water the zeolite-softening system will give good results.

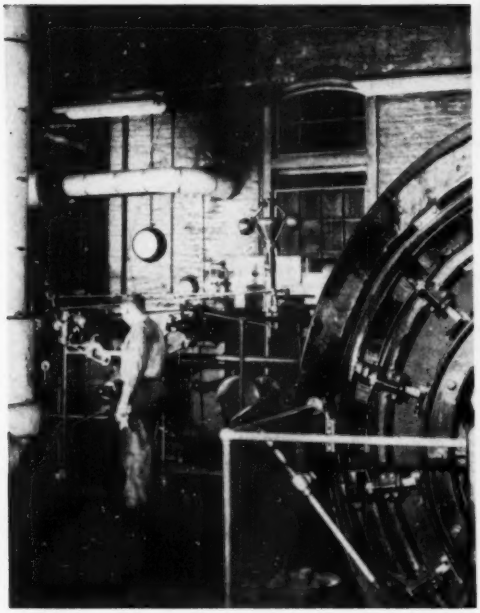
While the problem of selecting the right softener was a major one the fact that it was picked large enough for both boiler-room and plant-process use is a mark of good engineering. The softened water improves not only boiler operation but process equipment service as well. What's more, it prolongs the maintenance-free life of connecting piping and fittings—definite aids to a smoother control of the problems of plant engineering.

**Sound scheduling** is next in order of importance in the plant engineer's kit of tools. This covers not only the time of putting load on equipment but, where possible, balancing it out to give best results. For example, if the full steam load went on after lunch hour, or as soon as work started in the morning, the bump on boilers and associated equipment would be extra heavy. A little planning, and the boilers carry the load with no distress.

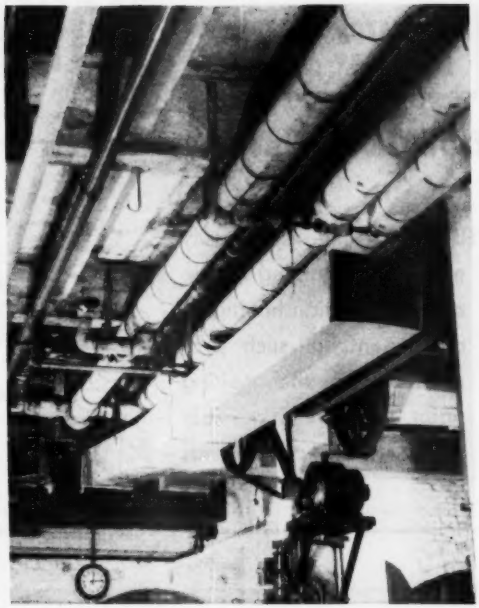
Since the plant shuts down weekends, routine overhaul can be scheduled to fit in with production experience. Heavier-than-usual production on certain machines can be compensated for by closer attention to the machines affected.

Major maintenance benefits from this weekend shutdown. It allows time to get together all replacement parts and have them ready as soon as the plant shuts down. Further, it permits shifting production loads if the maintenance job in question is expected to run over the weekend.

**Preventive maintenance** is third major aid in plant engineering. Basis for it is a knowledge of the job each piece of equipment does in the plant and its oper-



**STANDBY** 400-kw corliss gets turned over once a week; all equipment gets similar checking so engineer knows it's ready



**PLANT SERVICES** include steam, water, warm air for humidity control, motors; all under supervision of plant engineer

ating characteristics. Then a schedule is laid out for greasing and lubricating, inspecting, repairing, replacing.

Here are samples of how E H Nace, chief engineer, and George H Perkins, operating engineer, run preventive maintenance at the North American Lace Company.

**Motor Care.** One man is charged with the responsibility of lubricating all motors. He makes his rounds daily, roughly checks on bearing temperatures, looks over the motor, notes and reports on any trouble sounds. (The old ear-to-ground trick using a screwdriver as the sounding probe, and placing the blade end on the bearing housing and putting the ear to the handle end of the screwdriver, helps spot worn ball bearings or a loose inner race in antifriction bearings.) You can tell worn bearings on small motors just by joggling the shaft. With larger motors you have to measure the air gap on all sides of the rotor. If the gap above is greater than below, chances are the bearing is worn.

Each motor is cleaned regularly. Where necessary, windings are blown out to free them of lint on weekend shutdowns. Commutators are sanded and, if mica is high, the commutators are undercut.

A program is being set up so insulation checks are being carried on continually.

These checks are performed by megohmmeters and, to be effective, require a good set of records on the insulation history.

**Mechanical Drives.** A number of the production units are belt-driven. So belt tension is always watched. Best tension is to have belts just as slack as they can be without slip. And wherever possible the slack side should be on top. Belts should be cleaned and dressed with a good dressing regularly throughout their operating life.

If you have endless belts, look for any laps that start to open. Cement them down as soon as they show up. See that pulleys are in line if you notice persistent squeals and slips. Other steps toward preventing noisy, slipping belts are scraping off loose grain, using right belt dressing.

You can correct wobble by being sure pulley bearing fits the shaft snugly. Crooked belts may also be at fault. To avoid them, never force a belt over a pulley or over a high pulley crown that will stretch it out too badly on one side.

To loosen a belt move pulleys closer together and to tighten it move the pulleys farther apart.

**Traps and Piping.** All piping, traps, fittings and valves come under the plant engineer's charge. A good bit of the piping is under concrete or behind walls so adequate metering is the first line of preventive maintenance. Total water flow is closely checked. Boiler-room needs are known. Average production load is also recorded and the process-water consumption ties directly with production load. Any sharp difference and a check of the water lines is then in order.

Traps, fittings and piping get a thorough going-over when connected equipment is taken off the line for periodic checkup.

Sprinkler system is patrolled daily. One man checks all sprinkler outlets and makes sure pressure on the lines is where it should be.

**Inventory Control.** For almost all smaller equipment under the control of the plant engineer a running inventory is maintained. For example, all electrical motor parts are tagged and stocked. As the maintenance crew pulls them out of stock the tag is sent through for a replacement order.

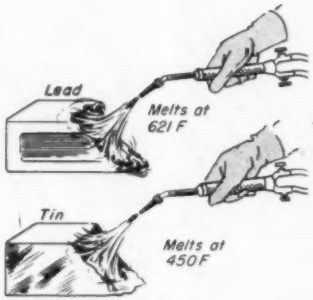
For pipes and fittings a duplicate of the stock-room material request goes up to the front office for a replacement order for this equipment.

**OPERATORS' NOTEBOOK 47**

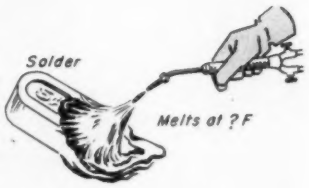
# NOW Low-Temperature

## EUTECTIC* PRINCIPLE

*EUTECTIC means easily melted. Pertaining to an alloy or solution having its components in such proportion that the melting point is lowest possible with these components

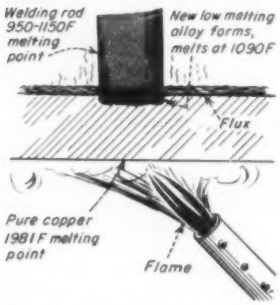



1 Every pure metal has its own melting point, 621 F for lead, 450 for tin

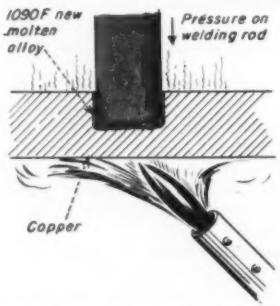



| Lead | Tin | Melts |
|---|---|---|
| 75% | 25% | 514F |
| 50% | 50% | 415F |
| 37% | 63% | 360F |

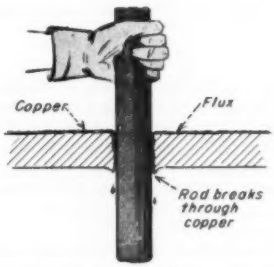
2 Melting point of solder varies, but may be much less than for tin or lead


Welding rod 950-1150F melting point
New low melting alloy forms, melts at 1090F
Flux
Pure copper 1981F melting point
Flame

6 New low-melting alloy forms and melts under rod at 1090 F; sinks in copper

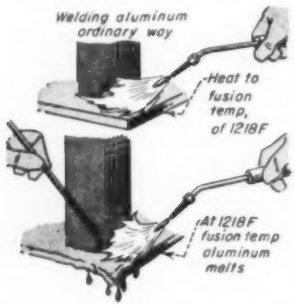



7 Keep pressing down on rod. As new alloy forms, rod keeps sinking deeper

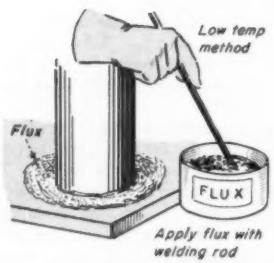



8 Rod breaks through. You did not have to heat copper to its melting point

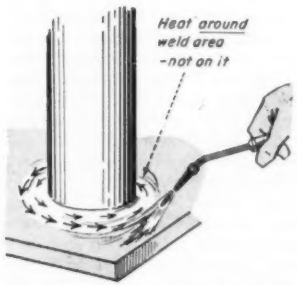
## WELDING ALUMINUM




1 Aluminum, welded usual way, needs fusion heat of 1218, can damage



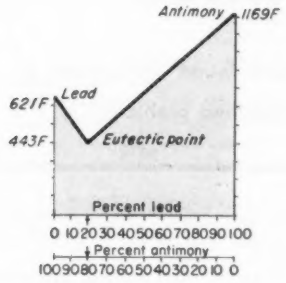

2 To low-temperature weld, first apply flux to area that is to be welded



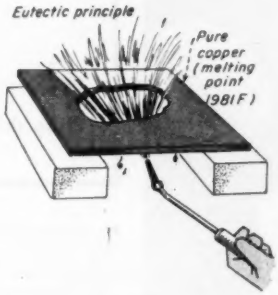

3 Play torch around area to be welded, not directly on it. That's important

# Welding Saves You $$$

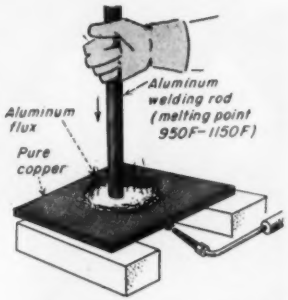
By STEVE ELONKA, Associate Editor




**3** Eutectic point of both is 443 F, but lead melts 621 F—antimony 1169 F

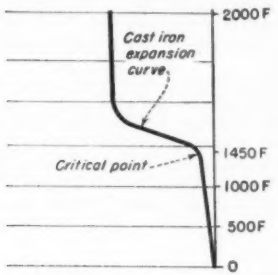



**4** Flame breaks through a sheet of pure copper at its melting temp of 1981 F

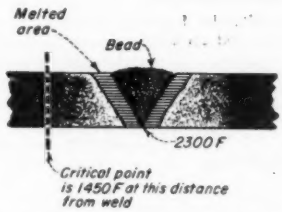



**5** New flux fuses aluminum rod to hot copper. Press down on aluminum rod

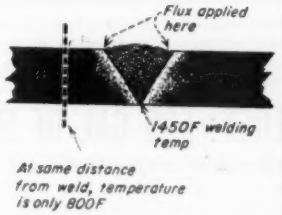
## WELDING CAST IRON



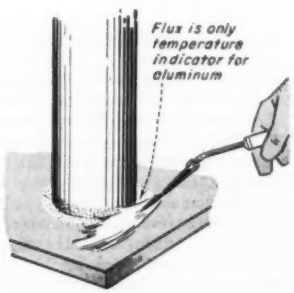

**1** Critical point for cast iron cracking is 1450 F. It expands fast there



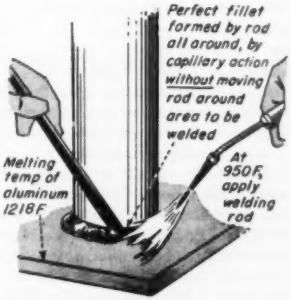

**2** Fusion welding heats metal above its critical point of 2300 F, beyond weld



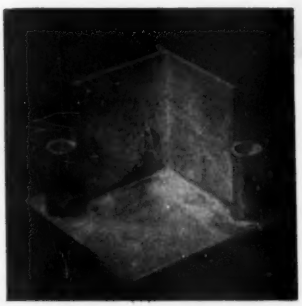

**3** Heat to only 1450 F with low-temp method; keep below critical point




**4** Melted flux (950 F) is temperature indicator. Apply the welding rod now


Perfect fillet formed by rod all around, by capillary action without moving rod around area to be welded
Melting temp of aluminum 1218F
At 950F, apply welding rod

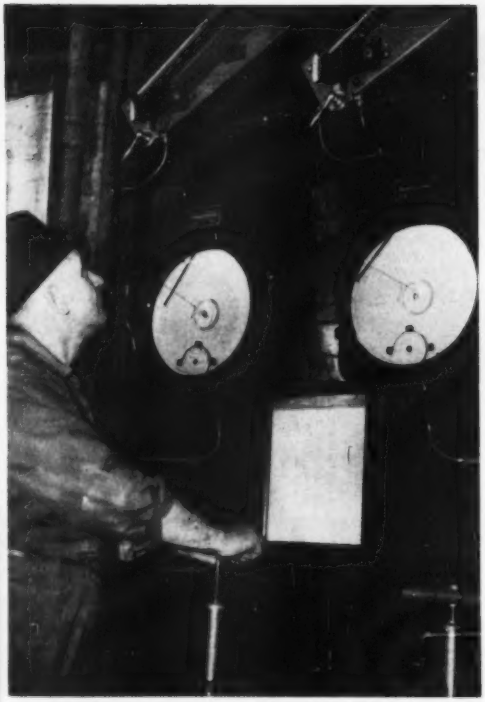
**5** Perfect fillet is formed all around by holding welding rod in one spot



**6** Low temp did not thin metal. Fillet is even and formed at all the joints

# Trouble-Shooting HINTS

**Could you have found the answer to these three operating problems?**



**FRED HOYER** checks his fuel oil soundings after he found bug in system. This sounding device proved to read correctly

## LOST: 528 GAL OF FUEL... until the alert chief engineer did a little exploring

► IN CONVERTING some of our boilers to oil, we installed two large fuel-oil tanks. Then we installed two pneumercator tank-sounding instruments.

In calibrating the tanks, we found that one held 19,621 gallons, and the other only 18,093 gallons. There seemed no good reason for this shortage of 528 gallons in our second tank.

The instrument firm sent over their trouble shooter. He made a few tests and reported his instruments were OK. But that still left me holding the bag.

I called the tank manufacturer. He could give no explanation for the 528-gallon difference. But I still had to know if that oil just didn't show up on the instrument, or if it wasn't in the tank.

These tanks are crammed into a close space and it isn't easy to check their outside surface. But after a tight squeeze, I found the trouble. The wall side of the tank has a flat area. Looks like the tank was dropped or bumped when unloaded from the truck, slightly denting its surface. After a little figuring, I knew that accounted for all that oil shortage. Just another case of a tough problem having a simple solution.

FRED HOYER *New York, N. Y.*

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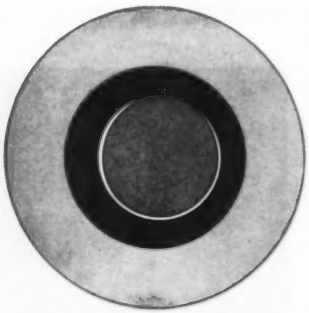

**GOVERNOR PIN** had high spot from wear on both sides, while bushing was also worn oval. High spot shown formed cantilever for the bushing to swing to and fro

## THE LIGHTS FLICKERED... but not after a simple little detail was corrected

► A SMALL PLANT supplied electric current to a wealthy community. Plant had two locomotive-type hand-fired 105-psi boilers and three engines, belt-driving ac generators of 2200 volts. Generators could be synchronized.

Engine No. 1 was a McIntosh Seymore, 350-hp tandem compound. It was too powerful for the plant load of about 80 kwhr. Engine No. 2 was a 112-hp cross-compound Armington and Syms; automatic cutoff, Rites shaft governor. No. 3 was a Russell single side crank, 60 hp. All three engines exhausted to atmosphere. This plant was a one-man job. The engineer did the firing and attended to all other duties.

**Trouble.** Engine No. 2 had done most of the work for years. But one evening, when demand for current was greatest, she began an erratic spree of governor hunting, flapping and snapping the belt. That shot the lights up and down, and the telephone rang constantly.

I couldn't synchronize under these conditions. Although No. 1 was too powerful for load, I cut her in. Then the steam took a toboggan slide to 45 psi, but stayed there easily. About I AM, the load was down to No. 3's capac-

ity, so I put her on the line quickly.

After tramming No. 2's governor spring, we removed the governor. Governor hanger pin was dry and rough on one side. Inside of bronze bushing (where it was forced against pin) was also dry and rough, showing wear. We cleaned and dressed the pin and bushing until they looked like new.

With governor assembled again, I brought engine up to speed and threw load on. She worked OK for a half hour. Then No. 3 was synchronized and No. 2 shut down. Satisfied the problem was licked, I went home.

The district super told me earlier that his office was swamped with telephone calls. Said main office would have more complaints in the morning. How right he was!

The super was a book engineer and so was of little help, save to answer the phone and make out the log. But he promised to be in the plant next evening if I needed him.

When he showed up, everything was going fine—until 9 pm. Then No. 2 started on a rampage again. We cut in No. 1. By that time, I was exhausted from long hours, so decided not to tackle that governor until next day.

**More Trouble.** The super had a maintenance engineer from the main plant come in next morning. He arrived and checked everything. The governor seemed to be working and he saw no reason why she wasn't OK. But he hung around that evening. About 8 pm the trouble started again.

Off came the governor. The pin and bushing were smooth as ice, with plenty of grease on them. The maintenance man said he didn't see why she should not work perfectly. Another trial proved she wouldn't. Since he had to be on his own job next morning, he shoved off. Said he'd recommend a new governor.

Next morning, we called the engine builder long distance. He suggested installing a dashpot on the governor. But why was a dashpot needed now, after the governor had worked OK so many years? As often happens, the manufacturer couldn't answer that.

**Worn Pin.** Again we tackled the engine. This time we carefully calipered the pin and bushing. The pin had a worn, flat spot on its entire 8-in. length where bushing was forced against it. That made it 1/32 in. dia smaller on that side, from original diameter.

Bushing was worn about 1/16 in. on its inside where it was forced against the pin. Although the bushing was free to roll around on the pin, it got stuck in one place. As the governor moved forward and backward through a small arc on the pin, this forward and backward rubbing of bushing on pin (without grease) caused rapid wear, sketch p 116.

**IRATE CITIZENS** kept the telephone ringing constantly. In the meantime, I was going nuts trying to find the trouble

Since the bushing was free to move around the pin, it was possible for bushing's worn part to rest on pin shoulder. That gave a fulcrum and lever effect, which rocked the governor. This jerky motion was transmitted through the eccentric and valve rods to the piston valve, thus changing the cutoff abruptly.

This condition was further aggravated because engine's pulley was 6 ft in diameter, while the generator's pulley was only 22 in.

We checked this theory by placing the bushing on the pin's shoulder. The engine was started and, sure enough, the governor rocked. Then we turned the pin 180 deg in its socket in the governor hub and made it fast. The bushing was placed on the pin and turned around by hand until an unworn part coincided with the pin's good part. This allowed the bushing to revolve smoothly on the pin, through its arc. It was fastened in this position with three small dowel pins.

**No More Flicker.** The engine was started again. This time, it worked perfectly. We ordered a new pin and bushing. After they were installed, lights were steady.

Reason we didn't find fault first time was we didn't consider importance of pin and bushing being perfectly round. That taught me a lesson I'll not forget.

J W BLAKE *New York, N. Y.*

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# JUST A RAG... yet it was enough to blow up the steam engine's crankcase

► A UNIFLOW STEAM ENGINE's crankcase exploded. Steam engine explosions in crankcases are extremely rare. In this one black smoke was seen coming from the crankcase vents, then the explosion followed quickly.

Examination showed the crankcase oil level was correct. But a small piece of rag was found in the oil. That rag partly blocked one of the oil lines, with the result that one bearing was partly starved for oil.

This caused the bearing to heat. Then the small amount of oil passing to the bearing was vaporized. The bearing's heat and the vapor's pressure caused the oil to ignite. The flame passed through the oil pipe to the oil sump and ignited the oil vapor there.

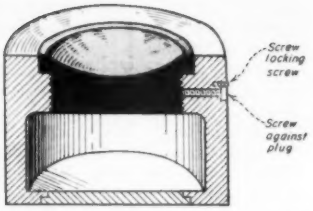
Rags left in oil sumps are dangerous because they restrict, but do not prevent, oil flow. So rags may pass undetected until they cause a serious accident.

W E WARNER *Woodford Green, England*

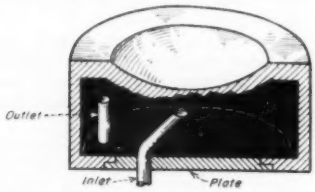
# Crack Down on CRACKED CROWNS

1 Why crowns crack
2 Preventing cracks
3 Cooling-water faults
4 Looking for cracks
5 Oil-cooled piston crowns
6 Repairing cracks
7 Right crown clearances

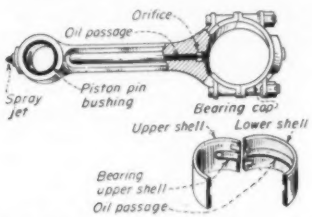
By C MORGAN JONES, *Marine and Stationary Diesel Engineer*




**1** Nickel-cast-iron plug repairs cracked crown, and it can be easily renewed




**2** Look inside the piston crown for corrosion and scale from cooling water




**3** Keep rifled connecting-rod passage and jet free so oil cools the crown

► "SURE, I SAW those little marks on the piston crown," wailed Mac. "They looked like scratches. If I knew then what I know now, that diesel would still be on the line."

Mac nodded toward the 600-hp diesel his mechanics were dismantling.

When Mac phoned that morning, he announced, "All hell is loose in the big diesel." When I got there and checked the engine, I found one piston crown had cracked at some time. Left unchecked, the crack crept around the crown until the ends met. So the loose section dropped out, making Mac believe that "all hell was loose."

Mac made the usual yearly overhaul. But it was the old story of passing over the piston by just checking the rings and piston pin. The piston was ignored as a piece of metal "that can't go wrong."

**Cracked Crowns.** Crown cracks often cause piston failure. Cracks can come from: (1) ineffective cooling or failure of cooling system (2) broken valve heads (3) injector tips dropping into combustion space (Head often gives before piston when this happens). (4) water leaking into engine through liner fracture (if piston's wet type) (5) cracks in cylinder head's water passages (6) water entering cylinder with starting air because operator did not drain air tank (7) defective injectors making uneven spray pattern, and causing excessive burning over small area of crown surface continually, and (8) tools left in combustion space. (Always check cylinder for that "lost" nut when putting on head. First turn engine over by hand. Then you know if it is inside.)

**Piston Dragging.** Before cleaning a piston examine closely for crown or land dragging, also skirt galling. Crown and land dragging leaves bright marks on piston between bottom ring land and piston top. This is from piston cocking over because of excessive liner or piston wear, or both.

Excessive dragging can also mean poor cooling. This causes extreme crown expansion. Then crown or lands will contact the liner, and this will frequently cause the piston to seize.

Piston galling or scuffing is also indicated by bright marks below lowest compression ring. Marks extend to skirt's bottom. This is from: (1) not enough clearance when piston is inserted (don't try to wear in a tight-fitting piston) (2) excessive temperatures (overheating from poor cylinder lubrication) and (3) lack of piston cooling. Heavy ring wear may also be from galling or scuffing.

If none of these conditions occur, clean piston thoroughly in fuel oil and dry with lintless rags or compressed air. If patches of carbon stick, dip in a hot solution of caustic soda.

With piston clean, look for cracks in crown. Cracks are usually about midway between crown's center and outer edge, rarely on underside.

**Preventing Cracks.** Pistons are cooled by fresh-air charge entering cylinder on suction stroke; also by piston rings carrying some heat to liner walls, then to jacket water. Modern pistons have oil sprayed or pumped to crown's under-

side. If oil supply is interrupted or reduced cooling oil remaining in piston will coke up. So examine piston's underside closely for coking.

When a crown cracks from heat because of poor cooling, it's often a series of small cracks, fanning outward from a solid and unmarked center.

Uncooled pistons are also subject to heavy carbon deposits on crown's underside. How? If piston-pin bearing is loose, oil sprays out against hot crown's underside. Then high heat cokes oil and bakes it on. But, as metal continually heats and cools on each engine cycle, this carbon flakes off. If carbon isn't caught by lube-oil filters it's apt to plug smaller lines.

Cracks often appear away from crown's center. These can be from heavy piston skirt wear, allowing crown to drag on liner wall. Cracks start from crown's impact, each time crown cocks and knocks at top of stroke.

**Aluminum Pistons.** Some green operators think there's something wrong with their new engine when a piston slaps on first starting up. This usually happens in diesels fitted with aluminum pistons. As aluminum's expansion is twice cast iron's, piston is loose when cold. But piston expands after warming up.

Some aluminum piston skirts are slotted for expansion. Piston body has molded bronze band to hold piston upright. That prevents slap until aluminum expands.

Cooling water in fresh-water cooled pistons also causes crown failure. That can happen if water has high mineral content. Then water directed against crown's hot underside deposits its mineral. So unequal cooling from scale insulation sets up stress areas, causing fractures.

Excessive corrosion can crack crowns, especially if there's much air in water. Protect crown by welding a pad to corrosion spot, Fig. 2.

**Bearing Shells.** Many new engines use spray cooling. Oil through crankpin bearing is forced up a bored hole in connecting rod to inside piston crown, Fig. 3. As crankpin bearings wear, oil intended for piston cooling splashes out of worn bearing shells. This causes piston cooling trouble.

Bearing shells of oil-cooled piston have a groove in top half, inside bearing edges. Oil holes pass through shells at the groove's end. Lower shell has a matching groove. These grooves accurately match holes in crankpin to receive oil and convey it through connecting rod to piston pin bushing; then through a spray jet into piston crown cavity.

If shell grooves don't register properly, piston starves for oil. Sometimes lower and upper shells are switched. The result? No oil for piston or piston pin. Crankpin bearing metal wiping can also block grooves and restrict oil flow.

At times spray jet inside piston crown gets damaged. Then stream of oil is misdirected to piston walls. Intensely hot crown soon expands enough to cause liner and crown damage. Or, if crankpin bearings are put up too tight, oil supply to piston crown is reduced.

**Worn Injector.** In some engines piston crown has job of providing a hot point where fuel oil impinges, so oil vaporizes and burns. But if too much oil continually hits one spot, excessive heat can crack crown.

If you can't find other causes of cracks, pull injector and check the tip, Fig. 4 and 5. Use a magnifying glass. If trouble is here, then it's from abrasives in fuel under high pressures. Also acid or sulfur in fuel, or in injector and piston crown has been subjected to excessive heat from working engine overloaded for long periods.

Some piston skirts have tinned coating less than 0.001-in. thick. If tinned surface is still good, wear has been negligible, or none at all. But if tin has worn off, check piston and cylinder liner for cause.

**Stop Spreading.** Very slight cracks may be prevented from spreading. Set piston in lathe and machine a circular groove in crown's surface. For crown metal 2 in. thick, make groove just wide enough to machine out the crack, and not more than $\frac{3}{8}$ to $\frac{1}{2}$ in. deep.

Another idea is to make piston plug of nickel cast iron, Fig. 1. First bore out entire cracked area and cut inside threads. Make a plug with shoulder and lock into crown with screws. Make sure plug's fit is snug.

Check plug's condition after running engine because if it fails, like Mac, you'll think "all hell broke loose."

Don't bolt plates over cracked surfaces; they soon burn through. Besides, they reduce cylinder capacity and throw engine off balance.

Simplest repair for small crack is drilling arrester holes at each end of crack. That stops crack spreading. Tap and plug holes.

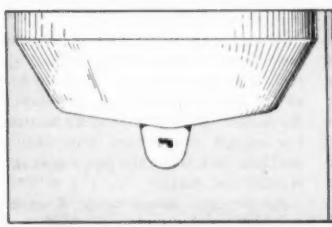
**Sewing Cracks.** Drill $\frac{3}{8}$-in.-tap-size holes along whole length of crack and tap them. Leave about 5/16 in. metal between holes. Tap holes and plug with steel studs.

This method works OK if used to stop a short, straight crack. But curved cracks often start off again. Often, crack travels a rough circle to join itself. Then loose center section drops out. There are commercial kits on market for "sewing."

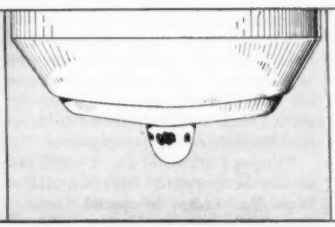
**Clearance.** If you pull a piston, insert a new liner, or repair any piston using heat, take clearances between piston walls and liner.

Adhere to manufacturer's tolerances. If none are available, a rule of thumb is to make piston diameter (cast-iron crown) 0.005 in. per in. smaller, the skirt only 0.0006 in., per in. smaller, because its cooler.

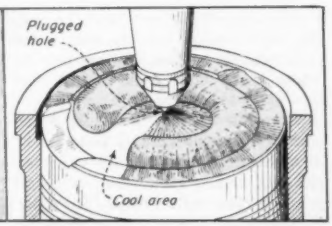
Piston-wear causes are: insufficient cooling, wrong starting methods, overloading the engine, dirty oil or intake air, incorrect cooling-water temperatures, badly balanced engine and fitting a piston with too little or too much clearance. These causes can be checked.



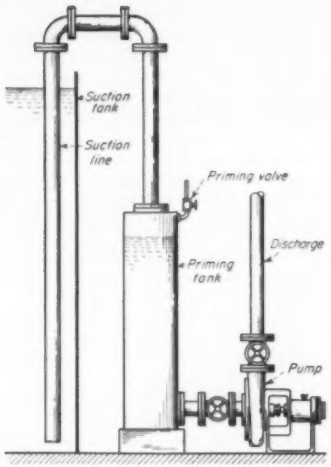
**4** Worn injector hole caused by dirty fuel or by a too large cleaning drill



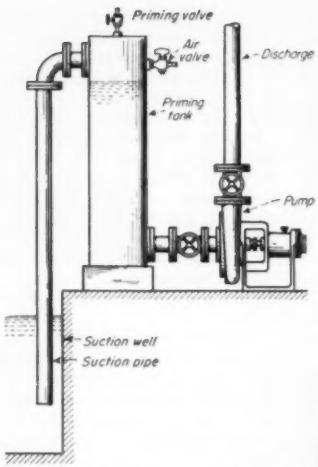
**5** Spray holes usually corrode from the oil's heavy sulfur or acid content



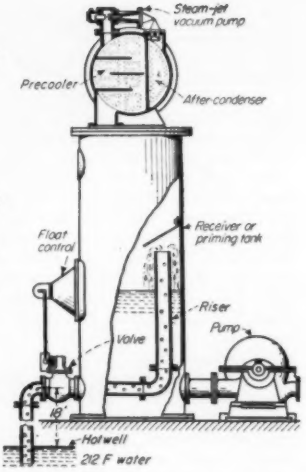

**6** Plugged injector hole causes a cool area on crown. This can start crack




**1** **TANK IN SIPHON** keeps pump primed over the side of liquid-storage tank




**2** **PRIMING TANK** keeps centrifugal pump primed after being put in service




**3** **STEAM-JET** vacuum pump and tank prime the pump when the water is hot

# Vacuum Tanks Make These

► PUMPS CAN BE MADE self-priming by connecting a tank in their suction line. There are several ways of doing this depending on the conditions. Generally, priming tanks are used with centrifugal pumps. But, where it is hard to keep a reciprocating pump primed a priming tank can be put in the suction line.

**Priming Chamber.** When a centrifugal pump is above its suction-well it can be made self-priming by connecting a tank (priming chamber) in the suction line, as in Fig. 2. Top of chamber connects to the suction well and its bottom to the pump's intake.

Before starting, fill pump and tank with water by opening the priming and air valves. When water begins to flow from the air valve, close both valves. Primer and pump are ready to start.

**Pump Primes.** After the pump starts it discharges the liquid from the tank into the discharge line. As level in the tank falls it reduces air pressure to where liquid flows from suction well into the priming chamber.

When this happens the liquid in the chamber becomes agitated and absorbs air. Mixture of air and liquid is pumped out until tank is filled with liquid and pump is completely primed. To insure the pump will be self-priming make the volume of the tank at least three times that of the suction pipe.

**Siphon Suction.** Many times in chemical plants liquid has to be pumped from tanks. Even though liquid in the tank is above the pump's suction it may not be advisable to connect the pump's suction into the side of the tank.

To avoid doing this a priming chamber and a siphon suction, Fig. 1, may be used. Before the pump is started the priming tank and pump must be filled with liquid. After this is done the pump remains primed, as long as the liquid in the suction tank is not pulled down too low. If this happens, air may be drawn into the priming tank to break the siphon and cause the pump to lose its prime.

**Pump Stopped.** When pump is shut down during normal operation the priming tank and suction line remain full of liquid. If air leaks in, it may break the siphon, but priming tank remains full.

When pump is again started, liquid level in priming chamber falls and creates a vacuum. Atmospheric pressure on the supply causes liquid to flow from the suction tank over the siphon into priming chamber to keep pump primed.

Priming methods of Fig. 1 and 2 can usually be assembled from material at hand. But, except in special cases, it is generally more satisfactory to install commercial automatic priming devices or self-priming pumps.

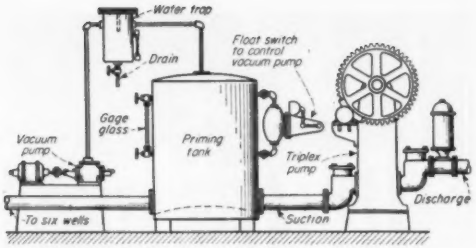
**Automatic Primer.** Fig. 5 shows an automatic primer connected to a centrifugal pump. It has a priming tank divided by a horizontal plate. Pump suction connects to bottom of lower half and its discharge goes to bottom of top half. Pump's motor is started and stopped by a float switch actuated by suction-well level.

An air valve on top of the priming tank passes air in or out of tank. A float in the valve closes it to prevent water flowing out. A small connection between top and bottom sections of tank acts as a vacuum breaker. This insures that priming tank and pump remain full of water after they are once primed.

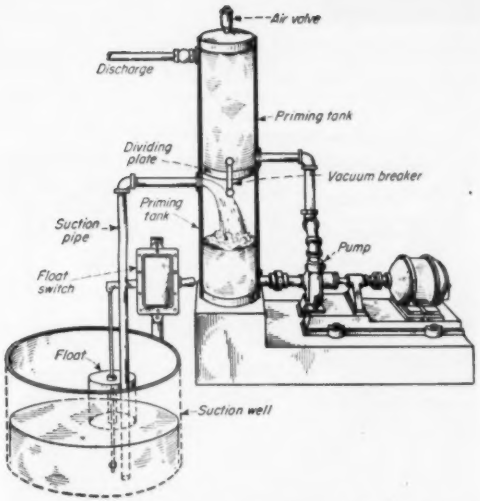
**Starting Pump.** To put the equipment in service remove air valve from top of tank. Pour in water to fill bottom half of tank and the pump up to suction-well connection. Replace air valve.

When pump is started it transfers water from bottom to top half of the tank. As water lowers in the lower half of the tank it reduces air pressure in the suction line. When pressure becomes low enough water flows from suction well into tank. Then the pump goes into regular operation.

After pump stops, water flows by gravity from the top into the lower half of the tank. Air enters through the valve into the top half of the tank. Water




**4** **DRY-VACUUM PUMP** and priming tank keep pump serving six wells primed. Suction lift is 25 ft, pipe length 300 ft




**5** **AUTOMATIC PRIMING SYSTEM** has tank divided into two sections, one for suction, the other for discharge of pump

***When you have trouble priming a pump maybe a priming chamber is the cure. Here are five ways to use chambers, good even for 212-F water, 18-ft lift***

# Pumps Self-Priming

By F A ANNETT, *Contributing Editor*

back-flow forces out any air that might be in lower half of tank. This leaves it and the pump casing full of liquid, ready for the next start.

**Other Requirements.** As on other pump installations, the suction line must be tight and free of air leaks. Pump stuffing boxes must be properly packed to prevent air leaking into pump. If water seals are used in the stuffing boxes, have them clean and in good working condition.

On dirty, greasy water, failure to prime after the first starting is likely to be caused by dirt stopping the vacuum breaker or air valve. The primer does not affect the pump's operation, other than to keep it primed.

**Hot-Water Priming.** Fig. 3 shows a method to keep a centrifugal pump primed when it is 18 ft above the surface of 212-F water. Equipment includes a receiving tank and a jet air pump with a precooler and after-condenser. A float valve controls rate of flow from the hotwell into tank. The centrifugal pump connects into bottom of priming tank as in the other hookups.

To start operation, the steam-jet air pump is put into service to create a vacuum in the receiving tank and riser. Vacuum in the riser causes some of the water to flash into steam. This cools the water so the vacuum can be reduced to where water flows into the receiver. This operation is assisted by the air-lift effect of steam bubbles in the water column in the pipe. As a result water comes into the receiving tank before vacuum alone could cause it to flow.

Some of the water flashes into steam and is condensed in the precooler. Air and other gases are removed by the jet air pump to hold the vacuum. Heat from condensing the vapors is recovered by passing plant makeup water through the precooler.

**Where Used.** This system can be used with filters, flat boxes, suction rolls and other services dealing with large volumes of air and vapor. There are also many places where hot water must be raised several feet from a hotwell to a pump.

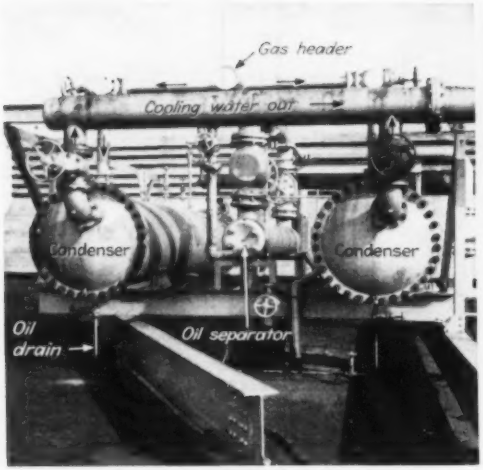
**Reciprocating Pumps.** When positive-displacement pumps and their suction lines are in good condition they are generally self-priming. The pumps also stay primed while they are in operation. But conditions can exist where they are not self-priming, or they may lose their prime after being primed and put into operation.

A large, vertical, triplex, single-acting plunger pump took water from six wells about 30 ft deep through a suction line 300 ft long. Suction lift was about 25 ft, which is unusually high for the conditions, even with reciprocating pumps.

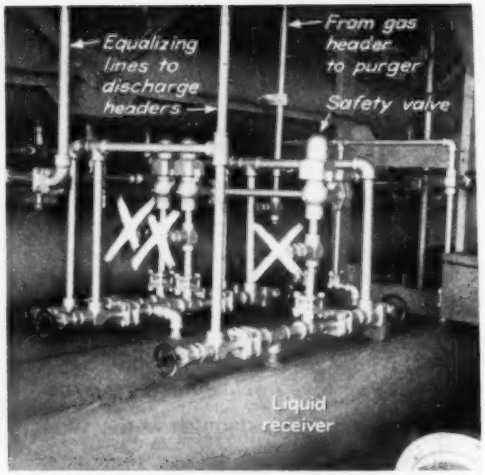
**Pump Lost Prime.** The pump would lose prime on one cylinder. After the usual methods of keeping the pump primed failed the priming equipment, Fig. 4, was installed. Tank in the suction line is 3 ft dia, 4 ft high. A motor-driven dry-vacuum pump connects, through a water trap, to top of tank. A float-operated switch on the side of the tank controls the vacuum pump.

**Vacuum Pump.** The float switch is placed to stop the vacuum pump when there is about 3 ft of water in the tank. When air collects in the tank and water level falls about 1 ft, the float switch closes. Vacuum pump starts and restores the 3-ft level in the tank. In this way a water supply is maintained at the pump suction at all times.

**Water Trap.** Trap removes any water from the air and gas before it gets into vacuum pump. A gage glass on the side of the trap shows level of the water. It is drained off before it gets high enough to be pulled into the vacuum pump. In Fig. 4 the vacuum pump with priming tank and float switch form an automatic primer. Float switch is the watchdog for the system. If anything happens that would tend to cause the plunger pump to lose its prime, the switch closes and the vacuum pump restores correct operating conditions.




**CLOSED SHELL AND TUBE** ammonia condensers placed on roof. Oil separator traps oil in the gas; drains to the sump




**WHAT'S WRONG HERE?** Never place the stop valves under the safety valves in any system. This hookup violates every code

# REFRIGERATION Q & A

By HARVEY C WELCH
*Retired Gen Manager, American Ice Co.*

## 27 questions often asked for unlimited refrigeration engineer's license

**Q 1—What is a refrigerating system?**

**A**—An apparatus or combination of mechanical equipment in which a refrigerant is circulated for cooling, or extracting heat from spaces or bodies.

**Q 2—Name two types of refrigerating systems in general use?**

**A**—Compression, absorption systems.

**Q 3—In what type of systems are generators, analyzers, and weak-liquor coolers used?**

**A**—In the absorption system.

**Q 4—In what type of system is aqua ammonia used?**

**A**—In the absorption system.

**Q 5—What is a refrigerant?**

**A**—A chemical compound or agent to produce refrigeration. Brine is not a refrigerant.

**Q 6—What is a compressor as used in refrigerating work?**

**A**—Compressor is a mechanical apparatus to draw evaporated gas from low-pressure side of system and to discharge it to high-pressure side, in a condensing system. Unit may be reciprocating, rotary or centrifugal.

**Q 7—A certain refrigerating system has a normal operating suction pressure of 150 psi gage and condensing pressure of about 1000 psi. What refrigerant is used? Ammonia, carbon dioxide or Freon?**

**A**—Carbon dioxide ($CO_2$).

**Q 8—Name several types of condensers in general use?**

**A**—Shell and tube, double pipe, atmospheric and evaporator.

**Q 9—Describe briefly an evaporating condenser.**

**A**—It has a series of tubes or coils, usually the fin type, enclosed in a sheet-metal housing. Cooling surface is often divided into two sections. Hot discharge gases enter the top section, where part of the sensible heat from the hot gases is removed. Water is sprayed over lower section in sufficient quantities to keep the surfaces wet. A fan or blower drives the blast of air over the cooling surface, causing rapid evaporation. This condenser has advantage of large capacity in small area, eliminates cooling towers.

**Q 10—What is meant by the term "direct refrigeration"?**

**A**—A system where the refrigerant is circulated direct to the spaces or substances to be cooled. It is usually called a direct-expansion system.

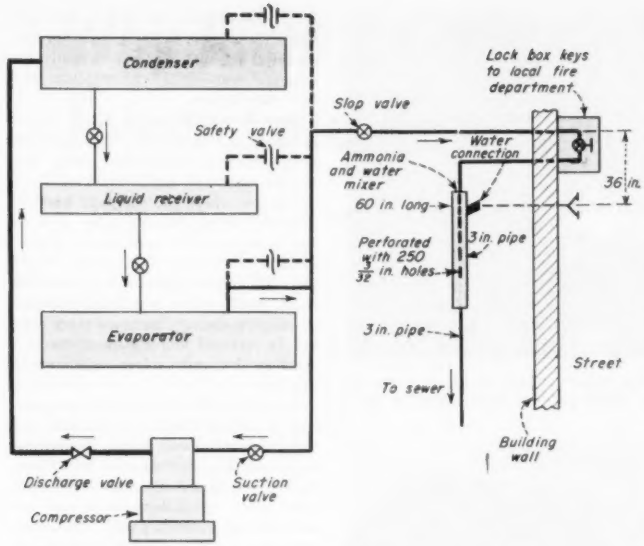
**Q 11—Is a direct-expansion system, with evaporating coils in the air-circulating system, permitted in public buildings?**

**A**—No. But certain types of self-contained portable units with solid soldered connections are approved. See your local code.

**Q 12—How are refrigerating systems usually classified as to capacity?**

**A**—This varies in the different municipal codes. In New York City, *Class A* is a common system containing 1000 lb of refrigerant or more and having a capacity of 30 tons or over. *Class B* contains less than 1000 lb and more than 20 lb and has a capacity of less than 30 tons refrigeration. *Class C* contains not more than 20 lb refrigerant.

**Q 13—What are hydrocarbon refrigerants?**




**AMMONIA MIXER** is important safety device for dumping large quantities of ammonia in emergency. Water absorbs the ammonia, washes it down into the sewer

A—They contain hydrogen and carbon, like ethane, propane and butane. These refrigerants, together with menthol chloride are flammable when mixed with air.

**Q 14—Are hydrocarbon refrigerants permitted in Class A systems?**

A—Many codes prohibit flammable refrigerants in large systems. See your local code.

**Q 15—Describe method of detecting leaks in a system using Freon.**

A—A halide torch is commonly used. This torch assembly has a copper plate enclosed in a metal shell, heated by an acetylene gas flame. The flame from this reaction plate changes to a greenish color when brought into contact with Freon gas. Leaks as small as .01% by volume may be detected.

**Q 16—How are small ammonia leaks detected?**

A—Gas leaks in open air are usually checked with sulfur sticks. These sticks consist of a heavy cotton cord coated with sulfur. When lighted and brought into contact with ammonia gas, the smoke given off turns white. Leaks in brine systems can be detected by a number of reagents.

**Q 17—State a general rule for locating safety valves.**

A—All pressure vessels, fired or unfired, that can be valved off as a separate unit, like brine coolers, receivers, accumulators and air tanks, must be protected by proper safety valves.

**Q 18—What is maximum pressure to set safety valves on ammonia accumulators and shell-and-tube brine coolers?**

A—150 psi gage.

**Q 19—What pressure is allowed on ammonia system's high-pressure side?**

A—250 to 300 psi.

**Q 20—Where should safety valves discharge?**

A—Discharge may be connected to low-pressure or suction side of the system or to atmosphere, depending on type and size of plant. Safety valves on brine coolers are usually discharged into the main suction line, just above the stop valve.

**Q 21—State two other locations that require safety valves.**

A—Ammonia compressors and generators must have pressure-relief valves connected below the main discharge valve, arranged to discharge into the main line above the stop valves. Many modern units have relief valves built into the header assembly.

**Q 22—What other valves are required in the discharge line above the main stop valve?**

A—A suitable check valve should be installed above the compressor, in the discharge line. Consult your local code.

**Q 23—Can you pack an ammonia stop-valve stem while under pressure?**

A—Ammonia valves have a machine surface on top of valve disk and bottom of valve bonnet. When valves are wide open, these surfaces seat, cutting off pressure from the valve stem, permitting packing under pressure.

**Q 24—In placing stop valve in compressor discharge lines, what precaution must be taken?**

A—Valve must be so placed that discharge gases enter the valve under the valve disk. Reason: Should the valve disk become loose from the stem, it cannot drop down and close off the line.

**Q 25—What is a pressure-limiting device?**

A—Many codes require a high-pressure cutout, so arranged that when a predetermined pressure is reached, controllers or oil switches in the power lines to the motors will trip and cut off the power. Some codes require a remote pushbutton station from which the entire plant can be closed down in a fire or other emergency.

**Q 26—What is an ammonia mixer and what is its use?**

A—There are several types. One is manually operated, another automatic. Each consists of a system of valves so arranged with connections to the ammonia, water-supply and sewer systems, that the entire ammonia charge may be mixed with water and discharged into the sewer system in a fire. Some codes require that these manually operated mixers be mounted outside the plant, in suitable heavy-metal cabinet. Keys to cabinets are supplied to local fire stations. See local code for special requirements.

**Q 27—State briefly how you would withdraw the ammonia charge from the plant, for reuse or transportation.**

A—In pumping out a plant, refrigerant must be discharged into drums, approved by Interstate Commerce Commission. Place empty drums on an accurate scale, with flexible metallic hose, between liquid ammonia connection and drum for accurate weighing. Never fill drums to more than 90% of capacity by weight, which would allow for a slight inaccuracy in weighing and prevent overfilling, as gas space must be left for expansion. Drums should never be placed outside in the sun. Only such quantities of refrigerant are kept in storage in drums, as the local code permits. Most metropolitan areas restrict this quantity to less than 500 lb, some permitting only 300 lb.

**1** Electric heating involves no lengthy piping system, traps, valves or vents. All you need is an electrical junction box where you will mount heating panel

**2** Next hang mounting for heating plate glass with its fused aluminum grid

**3** Then wire the fused grid to the electrical service and you're in business

# Maintenance-Free Heat

► EVERYBODY AGREES heating by electricity is clean, effective. Yet most everyone thinks its costs run sky high. Norwich Industries, Inc, in Norwich, N. Y., not only know this isn't so, but they also believe that with electric heating they will win both ways—in installation and in operating costs.

Here's what's behind their stand. They had two hand-fired 6000-lb-per-hr boilers serving their plant, but they were badly in need of replacement. What is more, the piping system needed overhaul. Estimates to do the whole job ran about $25,000. Fuel costs for the past two years had averaged between $10,000 and $11,000.

But Norwich found out that for $6000 it could get enough radiant-glass heaters, Fig. 1-3, to heat their 48,000-sq-ft plant. That meant 48 wall panels, Fig. 1-3, and 16 portable heaters. Norwich has placed expected cost of the electric energy for the actual heating at about $8000. (Note: This is based on an area with fairly cheap electricity.) The makers of the heating panels, Consolidated Radiant Glass Heating Corp, claim their method of heating can compete with oil or coal-heating where electric-energy costs are less than 2c per kwhr.

What they do is use a glass plate as the heart of their heating panel. On the back of this they fuse an aluminum grid. Electricity flows through this grid and heats the glass to over 300 F. The infrared rays given off by the hot aluminum pass through the glass plate and become distorted in going through. This distortion lengthens the rays so they behave very much like the rays of the sun. Result is a heat transfer that is 80% radiant heat and 20% convection. Quite different is the usual radiator that gives off its heat in almost exactly the opposite way—20% radiant heat and 80% convection.

**Installation.** It's fairly simple to put in these glass panels. Cost depends pretty much on local labor rates. But for domestic and small commercial installations where the company has had most of its experience, labor runs on the average of $75 per panel. Panels come in three sizes, 1000 watts (16x24 in.), 625 watts (15x20 in.) and 450 watts (6x27 in., a baseboard domestic or office model). The two larger sizes can be recessed into a wall or mounted right on the wall surface, as shown in Fig. 1-3.

Actual installation involves, first, putting in an electrical junction box and stud holes in the wall, Fig. 1. The mounting panel, Fig. 2, then goes into place. This panel carries an aluminum sheet with an air space between it and the back of the mounting panel. This sheet serves as a reflector plate and also as the support for an electrical terminal block, which covers the junction box.

The job is now ready for the last step, mounting the glass and aluminum heating panel, and wiring it into the terminal block, Fig. 3. This heat panel is hinged at the top for easy inspection of wiring connections.

**Operation.** Flow of electrical current in the fused aluminum grid raises glass temperature to around 300 F. This glass is about 20 times as strong as ordinary glass so there is little likelihood of its suffering any damage under normal use. The low conductivity of the glass prevents any blistering or searing from a quick body contact when turned on.

Vents at the top and bottom of the panel permit a natural convection air stream to flow into the air space between the back of the aluminum reflector and the front of the mounting panel.

Among the operating advantages for this type of heating is the ability to shut it down completely in the coldest winter months without fear of a freezeup. Further, once turned on, the heating unit puts out its full rated capacity without any delay for warmup.

What is its future? It could make a fair showing in areas where electric power is cheap and winters are mild, for example, the West or Southwest. At the moment, its major outlet is the domestic and small commercial field. It is planned, however, to use radiant-glass heat in the Paducah, Ky., atom plant. No matter what happens, though, it is important that the operating engineer know radiant-glass heat has already entered the industrial field.

# Why Right Cooling-Tower Care Pays Off

By HOWARD E DEGLER, *Technical Director, The Marley Co, Inc*

► PURPOSE OF good cooling-tower operation and maintenance is to obtain maximum results under varying loads and changing weather conditions. Important operating and maintenance considerations are: water treatment, delignification (removal of lignin from wood), 2-speed motors, winter operation, mechanical and structural maintenance. Let's take a quick look at each.

**Water Treatment.** Amount of makeup water needed depends on evaporation loss, drift loss and blowdown. Evaporation losses average 0.80% of water circulated for each 10-F range. Drift loss is amount of water carried out of tower by air currents. Properly designed induced-draft towers normally lose about 0.10% and most tower builders guarantee drift loss not to exceed 0.20%.

Blowdown wasted depends on hardness of circulating water, type of softening and drift loss. Blowdown is normally controlled to keep concentration of dissolved and scale-forming solids below point where scale forms or would be caused by corrosion.

Algae formations may plug nozzles, preventing proper distribution of water over tower filling. Growth may also collect on units served by tower, reducing heat-transfer rate. Hold algae at minimum or eliminate them. Use bromine, chlorine, chlorinated lime, copper sulfate or various blends of chlorophenates.

In control of algae, growth may become immune to algaecide. Switch to another for a period of time, after which return to original. Copper sulfate is often used because it is cheap. Utilize chemicals before too many algae are present; killing large amounts at once may clog nozzles and water passages. Shutdowns and expensive cleanouts may then be needed. So apply small amounts at start and increase gradually until all algae have been destroyed and pH can be controlled continuously.

Scale, caused by calcium and magnesium carbonates in water, can be reduced by softening makeup with lime and soda ash, zeolite or sulfuric acid. Or use small amounts of sodium hexametaphosphate. Consult competent chemist for regulation and control of both.

Control solids concentration by blowing down or continuous overflow to sewer. Too high solids concentration may cause sludge deposits or corrosion.

**Delignification.** Sodium carbonate in circulating water eats lignin out of any wood the water contacts. Lignin, which binds wood fibers together, is dissolved and leaves wood surface in white fibrous condition. Prolonged exposure reduces structural strength of wood. First parts of tower to show signs of delignification are those that are alternately wet and dry. High pH, 9 to 11, indicates harmful amounts of sodium carbonate. Neutralize with sulfuric acid to keep pH at 7 to 7.5 (pH of 7.2 is neutral for redwood).

**Two-Speed Motors.** These are good for seasonal decreases in heat load, especially for winter operation. When run at half speed, fans use considerably less power than at full speed. In multi-fan towers, 2-speed motors provide large savings though load reductions may call for only one or two fans at half speed.

**Winter Operation.** Freezing weather requires close attention to tower to prevent damage. Ice may accumulate on air-inlet louvers, especially on lower tower section and adjacent filling in induced-draft units. Structural overloads can occur, causing damage.

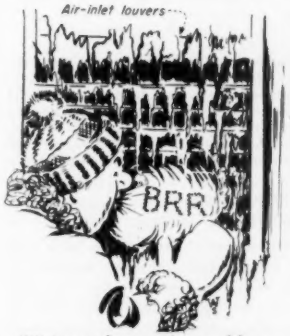
Mechanical-draft towers may have icing troubles, but these can be controlled or eliminated by attentive operation. Use 2-speed motors with reversing switches, especially in northern climates. Splashproof motors fitted with space heaters give good results. Increase water temperature over tower by (1) reducing fan-blade pitch for winter if connected to constant-speed motor (2) running some or all fans at half speed (3) stopping fans on some cells, or (4) stopping water flow over cells where fans are not operating, increasing water flow over other cells.

If ice forms on louvers and filling, remove by (1) stopping fans temporarily, but not water (when these cells have thawed, do same for other cells); (2) melting ice by reversing rotation of fan motor for 15-20 min.

**Maintenance.** Grease motor bearings with approved water-resistant grease every one to three months. Check insulation value of motor annually (use 1 megohm per 1000 v as practical minimum). Paint motor winding with insulation varnish and frame with rust-resistant paint yearly. Drain oil and refill speed reducers with proper oil every 3000 hr of operation or at least twice a year. Tighten fan-blade clamps and hub bolts, rebalance as needed.

Clean and paint all corrodible metals as required, especially fan blades and hubs. Redwood doesn't need painting for weather protection, but it can be done for appearance.

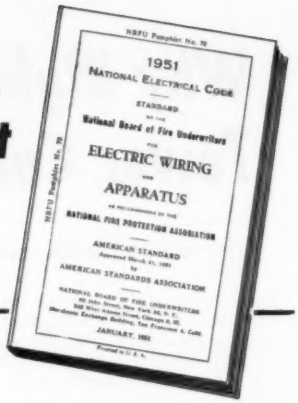
Two-speed motors save cash




Winter and operating problems

Good maintenance: happy tower

# Changes You Should Know About In the New Electrical Code




**Planning any renovations or new wiring? Then you'll need to check these important revisions in the new 1951 National Electrical Code published by the National Board of Fire Underwriters. Numbers at the end of each paragraph refer to sections of the Code**

## WIRING DESIGN AND PROTECTION

**Identification of Conductors.** New rule for 4-wire delta-connected secondaries with the midpoint of one phase grounded to supply lighting and similar loads: Now you must identify that phase conductor having the higher voltage to ground at any point where a connection is to be made and the neutral conductor is present. Painting or other effective means can be used. (*2005,d*)

**Branch Circuits.** For loads other than motor-operated appliances, total load shall not exceed branch circuit rating, except where the load will continue for long periods, as for store lighting, etc. Here the total load should be reduced to 80% of rating. (*2125,b*)

**Services.** Service-entrance conductors, formerly limited to No. 8 Awg wire, are to be no smaller than No. 6 wire—with the following exceptions:

1. For installations with not more than two 2-wire branch circuits they shall not be smaller than No. 8.

2. By special permission, because of limitations of supply source or load requirements, they shall not be smaller than No. 8.

3. For installations to supply only limited loads of a single branch circuit, such as small polyphase power, controlled water heaters and the like, they shall not be smaller than the conductors of the branch circuit and in no case smaller than No. 12.

4. The neutral conductor shall not be smaller than the ungrounded conductors when these are No. 8 or smaller. (*2304,a*)

If an emergency supply is provided to feed conductors controlled by the service disconnecting means, a new rule requires a disconnector that will open all ungrounded conductors from the usual supply before switching in the emergency supply. However other arrangements are permitted if agreeable to the authorities. (*2351,e*)

- Also, for switchgear in a vault, or metal-enclosed: If the voltage is 25,000 or less (instead of 15,000 as before), you can use a non-automatic switch capable of interrupting the rated load and suitable fuses. The rule that the switch must be interlocked with a circuit breaker in the secondary has been dropped. (*2389,a,2*)

**Overcurrent Protection.** Nonadjustable trip circuit breakers of the 0- to 30-amp class are now required to be the time-delay type. (*2403,b*)

**Grounding.** An important change now lets you use a local underground water-pipe system only ten feet long for a ground. This 10 ft may include any well casings bonded to the piping system. Section now reads: A metallic underground water-piping system, either local or supplying a community shall always be used as the grounding electrode where such a piping system is available. If the buried portion is less than 10 ft (including well casings bonded to the piping system) or there is some likelihood of the piping system being disconnected, it shall be supplemented by one or more of the grounding electrodes recognized in sections 2582 and 2583. (*2581*)

Then here's a new light on grounding requirements for alternating-current and service equipment: Any system grounding conductor or a common grounding conductor used for both system and equipment *must be a copper wire.* But for grounding only the service equipment, the grounding conductor may be either a proper size copper wire or its equivalent in current-carrying capacity of conduit, pipe or electrical metallic tubing. (*2594, also see table*)

## WIRING METHODS AND MATERIALS

**Conductors.** Two new types of latex-rubber fixture wire, *RUF* and *RUFF* appear in the list of approved insulated conductors. And the new moisture-resistant latex-rubber wire, *RUW*, is approved for general use and wet locations. Restrictions, prohibiting use of *Type T* thermoplastic-insulated conductors in raceways in sizes larger than No. 0000, have been deleted. (*3102*)

**Armored Cable.** Now armored cable may be run or fished in the air voids of concrete masonry block or tile walls where such walls are not exposed or subject to excessive moisture or dampness. (*3342*)

**Liquid-Tight Flexible Metal Conduit.** This conduit is a widely used newcomer for wiring machine tools, included in the Code for the first time. It's like common flexible conduit except that it has a liquid-tight outer coating similar to thermoplastic insulation. Here's the full text of Article 351 in the Code:

**3511. Scope**

Liquid-tight flexible metal conduit is not intended as a general purpose raceway material. The provisions of this article shall apply to a type of flexible conduit having an outer liquid-tight jacket and employed with suitable terminal fittings approved for the purpose.

**3512. Use**

The use of this wiring material shall be restricted as follows:

a. For the connection of motors or portable equipment where flexibility of connection is required.

b. Liquid-tight flexible metal conduit shall not be used under the following conditions: (1) Where subject to mechanical injury; (2) Where in contact with rapidly moving parts; (3) Under conditions such that its temperature, with or without enclosed conductors carrying current, is above 60 C (140 F); (4) In any hazardous location, except

as described in 5014-b, 5054 and 5073 of Article 500, unless it is specially approved for such use.

**3514. Maximum Size**

The maximum size of liquid-tight flexible metal conduit shall not exceed 1¼ inch electrical trade size.

**3515. Conductor Size**

The maximum size of conductor installed in liquid-tight flexible metal conduit shall not exceed following values:

| *Trade size of conduit, in.* | *Size of Conductor, Awg* |
|---|---|
| ⅜ | 16 |
| ½ | 12 |
| ¾ | 8 |
| 1 | 6 |
| 1¼ | 2 |

**Underfloor Raceway.** Metal raceways up through 4 in. wide, installed flush with concrete, are now allowed for power and lighting circuits. Before 2 in. was the limit. Code now reads: Approved metal flat-top raceways, if not over 4 inches in width may, in office occupancies, be laid flush with the concrete floor surface if covered with substantial linoleum not less than ⅛ in. in thickness or with equivalent floor covering. When more than one and not more than three single raceways are each installed flush with the concrete, they must be (1) contiguous with each other and joined to form a rigid assembly, or (2) spaced not less than ½ in. apart. (*3543,c*) Also you can use any size conductor up through No. 0 in raceways instead of the former limit of No. 4. (*3544*)

## EQUIPMENT FOR GENERAL USE

**Motors and Controllers.** In the 1947 Code, the maximum setting of motor-running overcurrent protection devices was 140% of full-load current. In the revised Code this 140% is limited to motors marked to have a temperature rise not over 40 C. Maximum setting for all other motors is 130% of the full-load current rating. (*4324*)

Also, for protection of 3-phase ac motors, in general only two overcurrent devices in any two conductors are required. But the enforcing authority may require an overcurrent device in each phase. (*4327*) (*See pp 122, 3, Sept* POWER *for further explanation.*)

**Transformers and Vaults.** Safety requirements for outdoor oil-insulated transformers have been rewritten and expanded as follows:

> Combustible material, combustible buildings and parts of buildings, fire escapes, door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on, attached to, or adjacent to a building or combustible material. Space separations, fire-resistant barriers and enclosures that confine the oil of a ruptured transformer tank are recognized safeguards. One or more of these safeguards shall be applied according to the degree of hazard involved in cases where the transformer installation presents a fire hazard. Oil enclosures may consist of fire-resistant dikes, curb areas or basins, or trenches filled with coarse crushed stone. Oil enclosures shall be provided with trapped drains in cases where the exposure and the quantity of oil involved are such that removal of oil is important. (*4324*)

Likewise the requirements for walls, roof and floor of a transformer vault have been completely rewritten:

> The walls and roofs of vaults shall consist of reinforced concrete not less than 6 in. thick, masonry of brick not less than 8 in. thick, of 12-in. load-bearing hollow tile or 12-in. load-bearing hollow concrete building units. The inside wall and roof surface of vaults constructed of hollow tile and hollow concrete building units shall have a coating of cement or gypsum plaster not less than ¾ in. thick. The vault shall have a concrete floor not less than 4 in. thick. Building walls and floors that meet these requirements may serve for the floor, roof and one or more walls of the vault. The quality of the material used in the construction of the vault shall be of the grade approved by the inspection authority having jurisdiction. (*4542*)

**Sealing Conduits.** In areas with flammable gases (Class 1, Division 1 locations), where two enclosures requiring seals are connected by a conduit run not over 36 in. long, only one seal need be used if located not more than 18 in. from either enclosure. (*5015,a*)

**New Flexible Cord.** Table 31, Chapter 10, titled Flexible Cord, lists a new Type *ET* elevator cable for lighting and control use in nonhazardous locations. New type has thermoplastic insulation, rayon braid with flame-retardant, moisture-resistant cotton outer covering.

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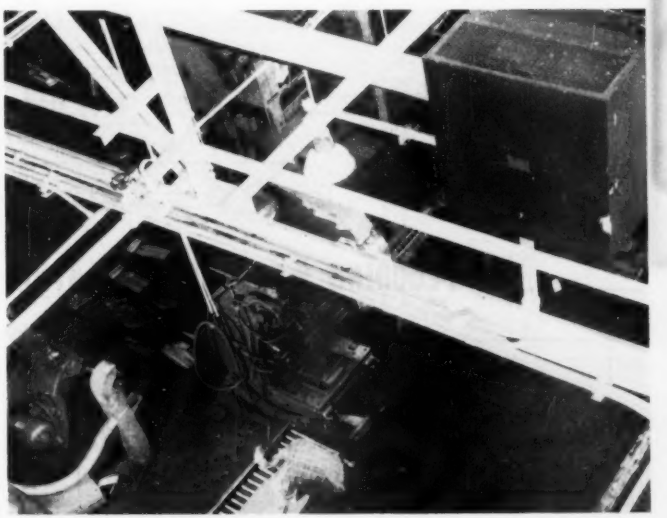
# You Need Just a Little Dc?

► TAKE A LEAF from the engineers at Westinghouse's Beaver Division plant. Not wanting to install motor-generator sets and distribution feeders to supply scattered direct-current machine tools, they chose small selenium rectifiers instead. These compact units plug into nearby alternating-current bus ducts, as shown at right, to keep the plant wiring simple and flexible.

Selenium rectifiers for this purpose are generally available in ratings from fractional to 15 hp.

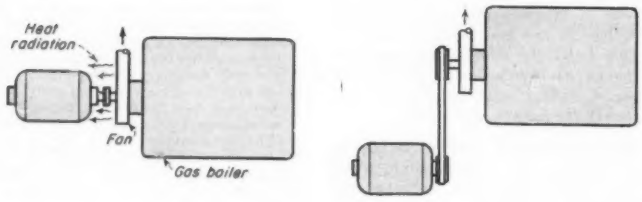


**THREE-HP SELENIUM RECTIFIER,** mounted on trusses, *upper right*, plugs into adjacent ac bus duct to supply direct current to motor of punch press on floor below it

# 4 Things the Plant Designer Forgot

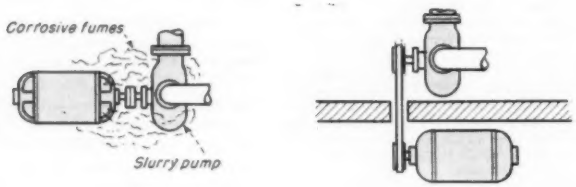
By S SPENCE, *Cheshire, England*

## 1 HEAT BURNS OUT BEARINGS



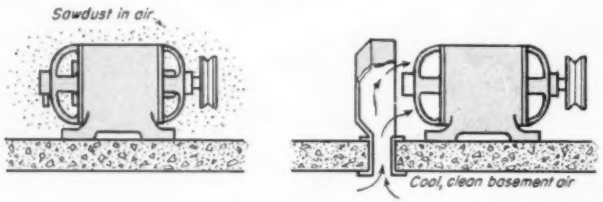

Despite the fact that electric motors are generally available to operate in almost any environment this side of Hades, here are four cases where the wrong type motor ended up in the wrong place. First take the case of the direct-driven induced-draft fan: Hot gas hitting the fan casing caused the motor bearings to overheat. We lost three motors in three months. Then we shifted to belt drive and had no more trouble.

## 2 FUMES EAT INSULATION



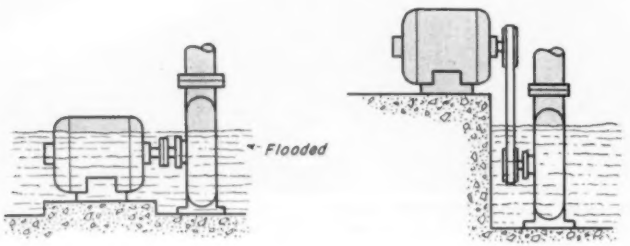

Here a direct-driven slurry pump gave off such corrosive fumes that the winding insulation was destroyed on several motors. Again we had to redesign the drive. This time we put the motor in a separate building to drive the pump through a long belt drive. Of course, motors are available for work in corrosive service, but this change allowed us to use a motor already on hand.

## 3 SAWDUST LOCKS ROTORS



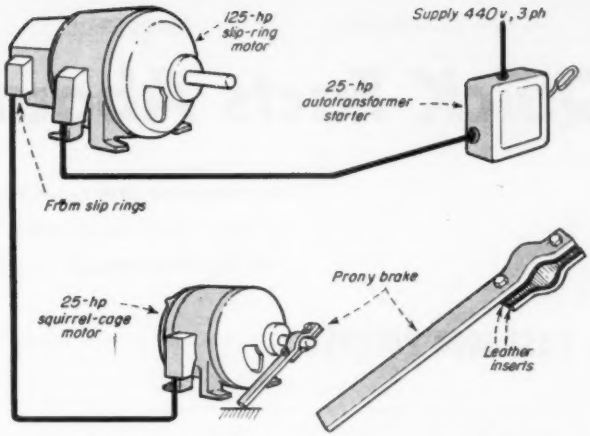

Dusty locations usually call for an enclosed motor, but somebody specified an open motor to drive the machines in the woodworking shop. In a short time the rotor was so tightly locked with sawdust that not even compressed air would clear it. After dismantling the machine to clean it, we built the special hood, left, to draw clean air from the basement. Cooler air also allows overloading.

## 4 FLOODING WEAKENS INSULATION




With direct-driven pumps there is often danger of flooding the motors, either by water leaking past the pump glands or failure of the pump to cope with sudden water rises. Simplest way we've used to avoid motor damage has been to raise the motor foundation and use belt or chain drive. Then any temporary water surges will not damage the motor's insulation. Enclosing wall is OK, too.

# Braked Squirrel-Cage Subs for Rotor Resistance




**AS STARTER IS THROWN IN,** 25-hp motor comes up to speed, 125-hp motor stands still. Then as 25-hp motor is braked down, 125-hp motor comes up to no-load speed

► WE HAD BROUGHT a 150-hp 1800-rpm slip-ring motor to the shop for general clean-up and rebabbitting of the sleeve bearings. As the motor was applied to a critical piece of equipment, it seemed advisable to run-in the new bearings in the shop where the job could be closely watched.

**No Starter.** But we had neither the equipment nor the available power for starting up a motor of 150 hp in the shop.

Motor's starter had been left wired in at the pumping station four miles away. And it was doubtful if we could draw enough current to start the motor even with the starter.

**Use Squirrel-Cage Motor.** But we did have a 25-hp motor with an autotransformer starter. So we hooked the starter to the primary of the slip-ring motor, as in the sketch, and fed from the secondary slip-rings to the 25-hp motor. Then we installed a prony brake loosely on the pulley of the 25-hp motor.

**Starting Up.** As the bolts on the brake were left loose, the 25-hp motor was effectively unloaded. As power was applied through the starter, the 150-hp motor became energized but did not turn. The 25-hp motor, however, came right up to speed.

Then the clamping bolts of the prony brake were slowly tightened to increase the load on the 25-hp motor. Speed began to drop on the 25-hp motor and the slip-ring motor began to turn. When the prony brake had been tightened enough to lock the rotor of the 25-hp motor, the 150-hp motor reached no-load speed. The large motor ran this way for a considerable length of time until the bearings were properly run in.

**What Happened.** As the 25-hp motor was loaded, it of course drew more and more current. This had the same effect on the wound-rotor motor as cutting out secondary resistance.

GEORGE O ELLIOT *Riverside, Ont.*

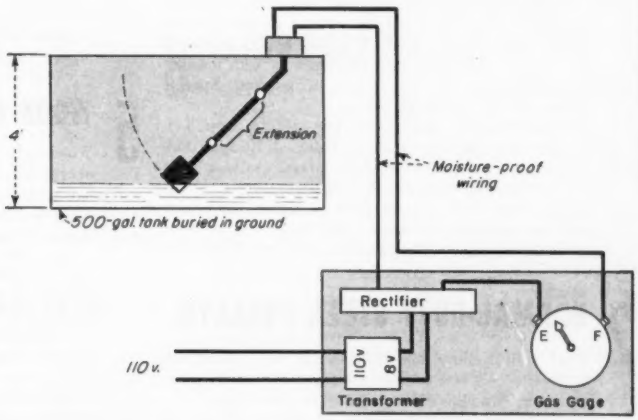
EDITOR'S NOTE: *If you want a high-falutin name for this type of hookup, try this one*—concatenation. *Incidentally, a similar, interesting hookup uses two separate wound-rotor motors on the same shaft; for example, a 4-pole 1800-rpm motor and a 6-pole 1200-rpm motor. The 4-pole motor is run alone for the highest speeds, the 6-pole alone for speeds near 1200 rpm. Then for intermediate speeds, the 4-pole's rotor feeds the 6-pole's stator, whose rotor, in turn, is controlled by a resistor.*

# Auto Gas Gage Indicates Fuel-Oil Tank

► I RIGGED UP THE DEVICE at the right to indicate the contents of our underground fuel-oil tank with a gas-tank float and gage from a junked automobile. The float had to be fitted with an extension so it would touch bottom when tank was empty.

NEWELL G NELSON *Aurora, Ill.*

EDITOR'S NOTE: *Why not simplify it and replace the transformer and rectifier with dry cells and a pushbutton?*




**LEVEL AT A GLANCE** using salvaged auto gas-tank float, gage. Operator no longer has to make daily trip outside to measure fuel-oil level in buried tank with stick

# QuicK Facts About Pulleys

***Here are the pulley types you meet in most power-transmission systems, their construction, sizes, belt tensions, rim speeds and best applications—from the Power Transmission Council***

## 1 CAST-IRON PULLEYS

Cast-iron pulleys are suited for practically any service, especially chemical plants, tanneries, etc, where too much dampness or acid fumes may be bad for other pulley types. Being heavy, they are often used where flywheel effect is needed.

Sizes run from 3-in. diameter by 2-in. face to 72 in. by 40 in.; larger sizes made to order.

Pulleys usually come with crown faces (sketch) or flat face, flanged, taper cone or step cone. They have solid rim and hub, solid rim and split hub, and split rim and hub. Center can be split or solid web, or split-arm type. Splitting arms gives added strength for rim speeds above 4500 fpm. Split pulleys can be more easily installed on existing shafts.

Flanges may be added to outside of rim to retain belt, keep two belts separate, or aid in shifting belt from a loose pulley to a tight pulley. Flanges inside of rim help stiffen it, can be used to bolt two pulleys together.

Pulleys can be fastened to the shaft by standard square keys or with metallic bushings for compression fastening. Compression fastening is OK for most average applications. Interchangeable bushings let pulley be used on any size shaft up to its bore. Where loads are severe or subject to shock, better use key fastening.

Standard pulleys are designed and built to take a stress of 65 lb tension per in. width of medium double leather belts, or equivalent. They can also be furnished for heavy double belts with 90 lb per in. with tension, or triple belts with 120 lb per in. tension. Special designs go up to 210 lb per in.

Maximum rim speeds, feet per minute, are: (1) regular iron pulleys—split or solid—3750 fpm (2) regular iron pulleys—specially balanced—solid or split—4500 fpm (3) split-arm iron pulleys—specially balanced—6000 fpm (4) specially designed solid iron pulleys—specially balanced—7000 fpm.

Cast-iron pulleys should not be run over 7000 fpm.

## 2 NORMAL-DUTY STEEL PULLEYS

Steel split pulleys are for general use where not subject to excessive acid or moisture. They are lighter than cast-iron pulleys, less brittle, and cost less.

Construction is a riveted or welded assembly of pressed or rolled steel parts formed from rust-resisting steel sheets. Sizes run from 3x3 in., up to 144x36 in. They come in flat and crown faces, may have single or double outside flanges.

Fastening is by interchangeable bushings; bushings may be key seated. Regular service is for medium double leather belts with 65 lb tension per in. width, or made special for heavier service. Maximum rim speed is 5000 fpm, unless specially made.

## 3 HEAVY-DUTY STEEL PULLEYS

These are made especially for heavy belt pulls, shock loads, peak loads or irregular stresses, to carry any kind or thickness of belting under most any conditions of service.

Heavy-duty pulleys come split or solid in sizes from 16x16 in., up to 192x50 in. They may be had in crown or flat face and in all regular forms including taper cones. All fasten by key.

## 4 IRON-SPIDER STEEL-RIM

These are built for higher speeds than regular cast-iron or normal-duty steel pulleys; lighter than cast-iron; available for extra-heavy service.

Shaped steel rim is riveted to cast-iron spider. Steel rim is ground, pulley then balanced. Construction eliminates casting shrinkage strains.

Sizes run from 8x3 in. up to 72x50 in. with crown, flat or special faces; solid or split with key or compression fastening. Maximum rim speed is 6000 fpm, higher speeds available when specified.

## 5 WOOD PULLEYS

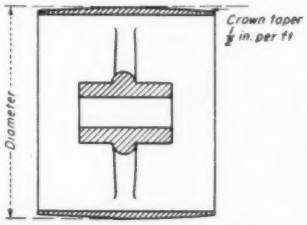
Wood split pulleys can be used for any application except where extreme moisture is present. They are made up of courses of wood segments keyed and glued to each other; lightweight and well suited to shock loads because of their resiliency; low priced.

Sizes run from 3x3 in. up to 120x24 in. with crown, flat or taper-cone face. Fastening is by bushings for regular duty. Heavy-duty pulleys use square keys in hub.

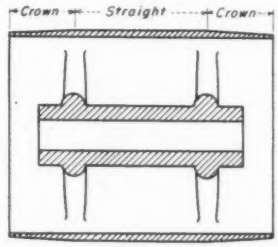
In addition to regular duty for medium double belts at 65 lb tension per in. width are wood motor pulleys and extra-heavy-duty wood pulleys. Motor pulley has a seamless steel bore. Extra-heavy-duty pulley is made for heavy recurring shock loads that might break iron or normal-duty steel pulleys.

Maximum advisable rim speed is 5000 fpm.

## STANDARD FACES

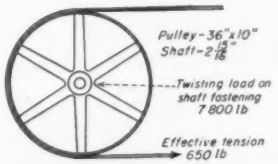



**CROWN FACE** is usually supplied unless specified for flat face, flanged, taper cone or step cone

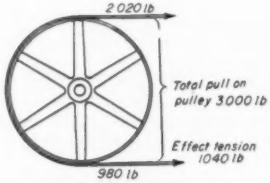



**WIDE-FACE** double-arm pulleys are flat between arms. Wood-pulley crowns are more oval than iron

## SHAFT LOADS

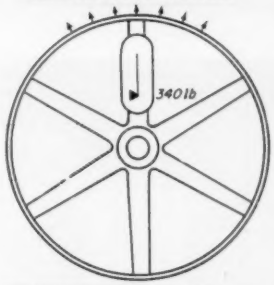



**TWISTING LOAD** on shaft fastening is effective belt tension times ratio of pulley to shaft diameter

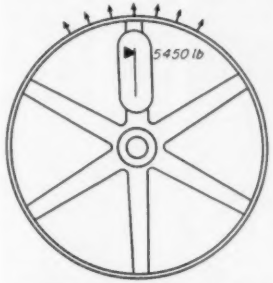



**EFFECTIVE TENSION** = 2020 - 980 or 1040 lb. For 16-in. belt, this is 1040 ÷ 16 or 65 lb per in. width

## CENTRIFUGAL FORCES




**CENTRIFUGAL FORCE** on 50-lb segment of rim on 48-in. pulley running at 100 rpm is about 340 lb




**AT 400 RPM,** since centrifugal force goes up as speed squared, force is sixteen times as great

# 6 IRON-SPIDER WOOD-RIM

Lightweight and relatively greater strength permit running these pulleys at speeds that would break most iron or steel pulleys. Pulley rim is segmented maple blocks; spider has iron arms and hub but no rim. Maple blocks are stronger than same weight of iron; casting spider without rim avoids shrinkage strains.

Sizes run from 8x3 in. up to 72x40 in. in solid, split and split-arm constructions. They will take heavy, double leather belting at 90-lb tension per in. width. Fastening by standard keys.

Maximum recommended rim speeds are: (1) regular split pulleys—5000 fpm (2) regular solid pulleys—6000 fpm (3) regular split-arm pulleys—6000 fpm (4) special solid pulleys—10,000 fpm (5) special split-arm pulleys—10,000 fpm.

# 7 COMPRESSED-WOOD PULLEYS

These are made of laminated layers of soft wood cemented together and compressed to 30 to 50% of the original thickness to form a hard, tough, dense material. Tapered cast-iron hubs are forced into undersized holes of blocks of this material.

These pulleys may be used for practically any service, especially for motor and machine applications. They are waterproofed to withstand normal moisture conditions. Sizes run from 1½x1½ in., up to 50x30 in., crown, flat, taper cone, step cone or external flange. Top rim speed is 5000 fpm, unless specified higher.

# 8 PAPER PULLEYS

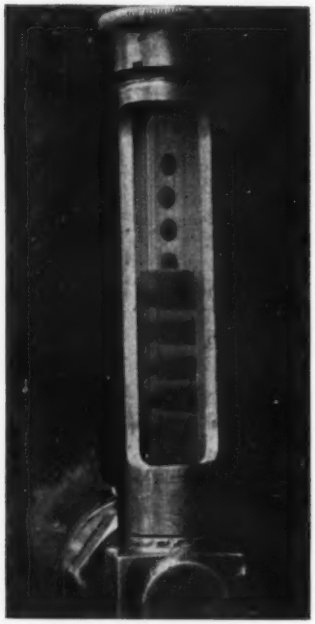
Paper pulleys can be used for practically any service under practically all conditions. They are particularly suited to motor and machine applications, will take normal moisture, and can be specially waterproofed for excessive moisture or outdoor exposure; will withstand heavy shock and peak loading.

Rims are made of fiberboard pressed together with edges to the pulley face. Small sizes have hub cast within the fiber. Medium sizes have a sleeve inserted within the fiber, while large sizes have a cast spider for normal duty or a web center for extra-heavy duty.

Paper pulleys come in sizes up to 72-in. diameter and any face width; crown face, straight face, taper cone, step cone, grooved face, and any external flange arrangement, large variety of hubs and special constructions. They are available in solid, solid rim and split hub, or completely split; keys or bushings.

Maximum rim speed is 5000 fpm, or 10,000 fpm if specially balanced for high speed.

# PRACTICAL IDEAS... *here's the trading post for your*



## Reliable Level Gage

SOME LEVEL GAGES are made of a glass tube, protected by a metallic sheath with a window open on the front face. Inner wall of the sheath is covered with white paint.

Trouble is level is hard to read if liquid is colorless. My photo shows a simple solution. This level gage for transparent liquids is based on the refraction phenomenon.

To make, drill small holes in sheath as shown. These holes are in back of liquid and appear distorted through it.

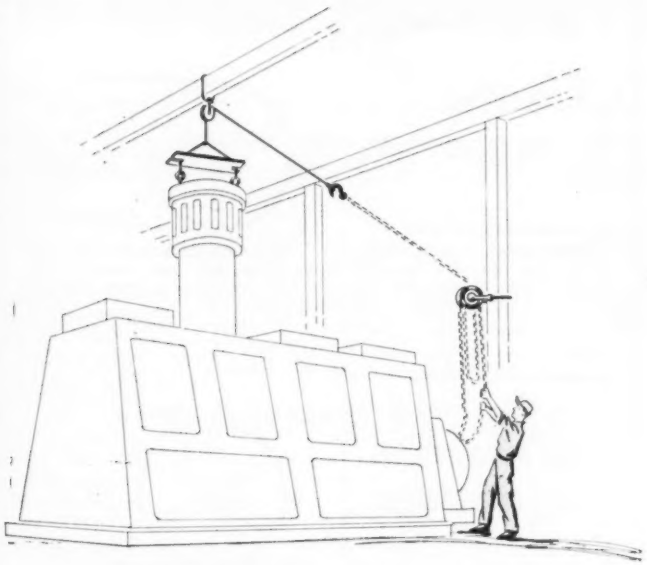
Before making gage shown, we had to look close at colorless oil in glass. Now level is easily visible at 30 ft. When gage is empty, all holes seem round. When full, holes are oblong.

P A ROUBINET *Comines, France*

## Have Starter Handy

IN OUR PUMP ROOM we have several important pumps. To insure against delay from a starter failing, we have a spare starter mounted permanently on the wall. Starter has leads long enough to reach any pump motor. That starter standing by takes a load off our minds.

G LINDGREN *Troy, N. Y.*



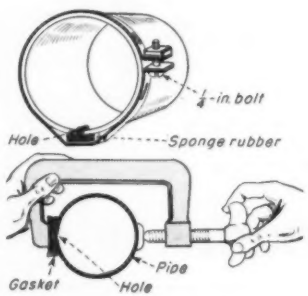
## NO HEAD ROOM? USE YOUR HEAD

EVER TRY PULLING a heavy piston assembly or liner that had little head room, with a chain block and tackle? Here's how to do the trick.

Replace the chain block with a single sheave pulley block as shown. Pass a wire sling through the sheave and attach the chain fall to any convenient wall, upright, bulkhead, or even to a ring bolt in the floor.

Thread the chain fall hook through the eye of the sling. Then heave away. Piston assembly will clear top of engine without any wangling, heaving, shoving or cursing.

C MORGAN JONES *New York, N. Y.*




## Quick Leak Stoppers

OUR LARGE STEEL hot-water tank sprang a half-inch leak at the bottom. We didn't have welding equipment and what's more we needed the tank badly.

First, we placed a piece of ⅛-in. rubber sheet packing, backed up with a piece of sheet iron, over the hole. We held these in place with a strip of one-inch perforated pipe-hanger band iron, shown. Still the leak wouldn't stop.

Next, we tried sponge rubber. That did the trick. Reason was that sponge rubber pressed into rough tank surface snugly.

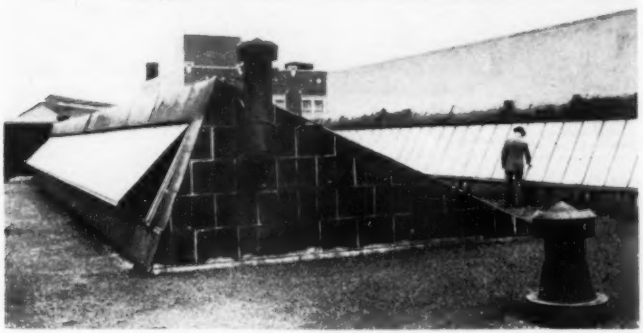
I stopped many leaks in steam and water lines by using a C clamp over hole as shown. A piece of gasket clamped against the leak usually stops it until a permanent repair is made.

If pipe is large and no C clamp handy, use a perforated pipe band iron.

H A JAHNKE *Milwaukee, Wis.*

# operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*



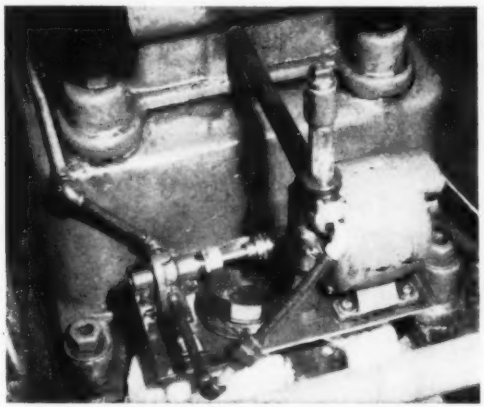
## NO CRACKED SKYLIGHTS NOW

WIRED GLASS PANES in these 80-ft skylights cracked from opening and closing. Strain broke glass as the long skylights were cranked open or closed by hand. So we replaced glass with Plexiglas acrylic plastic panes.

The new panels, each 2x5 ft, and ¼ in. thick, proved to have strength and resiliency needed to withstand the twisting that sets in when skylights are raised for ventilation.

Besides, the panels diffuse more comfortable, glare-free light.

H W SMITH *New York, N. Y.*



## PUMP STOPS BURNED BEARINGS

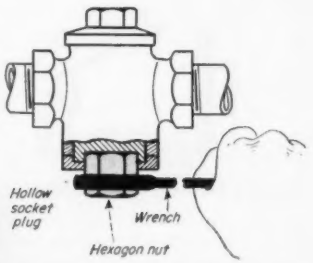
IN A BIG LAUNDRY you can't watch your whole establishment and keep your eyes glued on your large air compressors at the same time. There are too many things needing an engineer's time, in the power plant and out in the laundry.

After burning out a crosshead bearing on one large horizontal compressor, and a main bearing on another machine, I bought two gear-type pumps and fractional-hp motors. Then I hooked up pump's discharge to all bearings.

Photo shows hookup that keeps forcing oil to all bearings on compressors. Suction is taken from compressor sump and forced back through bearings.

I find bearing wear almost negligible now. No trouble in over four years! Just keeping enough clean oil in sump is easier than filling and adjusting individual oil cups, monkeying with wicks.

F BECK *Trenton, N. J.*

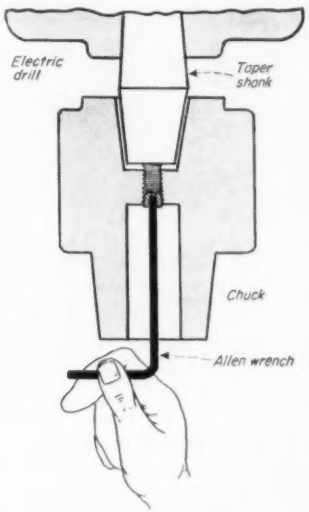



## Emergency Plug Wrench

SOME THREADED PLUGS on automatic valves and other types of equipment have a hexagon or square hollow socket for turning.

If you don't have a suitable plug wrench, use a hexagon or square steel machine bolt nut and an open end wrench, as shown.

T TRAIL *Catonsville, Md.*



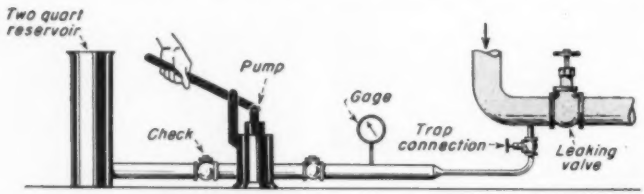

## Chuck Getter-Offer

EVER TRY to drive a drill chuck off its taper shank? Then you know it isn't easy. Our repairman gets away from it by drilling and tapping a small hole into the center of the chuck, sketch. He uses a hollowhead Allen screw. Then by turning the screw, it jacks chuck off shank easily.

G LINDGREN *Troy, N. Y.*

# More PRACTICAL IDEAS

Begins on page 132




## Here's Handy Valve Sealer

ON OUR AUXILIARY 200-hp steam turbine, we had to shut off main gate valve to turbine so we could reseat turbine trip valve. But the gate valve wouldn't shut tight.

We attached a hydrostatic hand pump, sketch, to trap line ahead of shutoff gate valve. We pumped a couple of quarts of solution ahead of the valve. Solution was one can of fibrous automotive radiator sealer and water. That completely sealed the steam leak around the gate in a few seconds. This valve is on a steam line that is seldom used.

Equip hand pump with a gage to avoid excessive pressures. Pump can be used to unplug static lines, like gage or meter lines, that will not blow free. Use plain water.

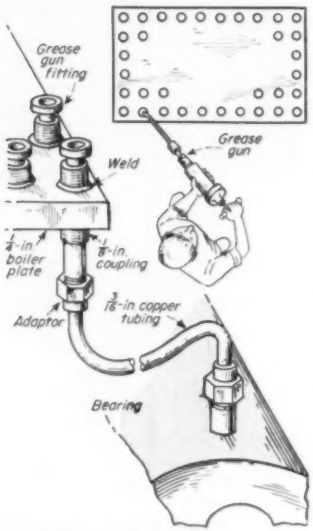
T P MONAHAN *Salt Lake City, Utah*

## "Oil-Proof" Grout

USUAL METHOD of fixing bolts in stonework or bridgework is to cut a hole for the bolt and then grout it in with cement. Trouble is cement's attacked by oil. For fixing bolts in either stonework or cement litharge-glycerin cement is good. This is made from 3 lb dry litharge to 1 lb glycerin.

This strong and efficient cement is not affected by oil. It's used same as cement. At surface, spread well around bolt to protect against oil.

W E WARNER
*Woodford Green, Eng.*




## Grease Gun Console

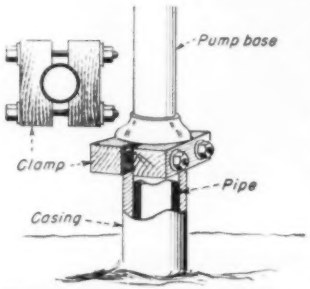
AFTER RENEWING every bearing on our steam crane (some aren't easy to get at) I found greasing them was *some* job. To get at bearings, you have to twist into a pretzel or stand on your head.

From the instruction book, I learned best time to grease bearings is at end of day when they are warm. That helps grease to flow. But the book didn't consider the guy who's had a hard day's work and says, "To hell with it. I'll do it tomorrow. Right now I'm going home to my wife and kids and the TV."

To solve this problem, I got a sheet of 1/4-in. plate iron, drilled 70 holes for 1/8-in. pipe couplings and welded them in. Then I piped up 3/16-in. copper tubing to all the bearings. With an adapter on bearing end of each tube, bearing is easily removed after unscrewing adapter.

Now the operator hooks his snap-dot grease gun to the fittings at the end of the day and plays a tune on the "console." The job is done in a jiffy from a sitting position, instead of climbing all over the contraption.

R H CARTER *Uxbridge, Mass.*




## Clamp That Pump Pipe!

EVER HAVE TO fish a pipe out of a well after it loosened up from vibration? I had that happen on gas engine—electric motor—and hand-operated pumps. Finally, I got wise and made the two hardwood clamps shown. Now when a pipe works off from any cause, it stays put until it can be repaired.

W B KENNEDY *McCool, Miss.*

## Handy Latch Repair

LITTLE THINGS can cause big headaches. When the door latch on one of our ancient elevators went haywire for the umptieth time, I decided to do something. Replacement parts had gone off the market a long time ago. But, of course, the elevators had to be kept running—safely.

The latch is a little thing made of brass. And there's one on each floor for each elevator. Trouble was the soft metal wore quickly and, though easy to repair, it did take time. Besides, it kept the elevator out of service.

Then I tried All-State No. 13 Build-Up nickel-silver brazing rod and flux. I found it easier and quicker to apply than rods used before. And it has proved to wear many times longer than most wear-resistant steels. My photo shows door latch so repaired.

This idea of hard surfacing has many applications in busy plants.

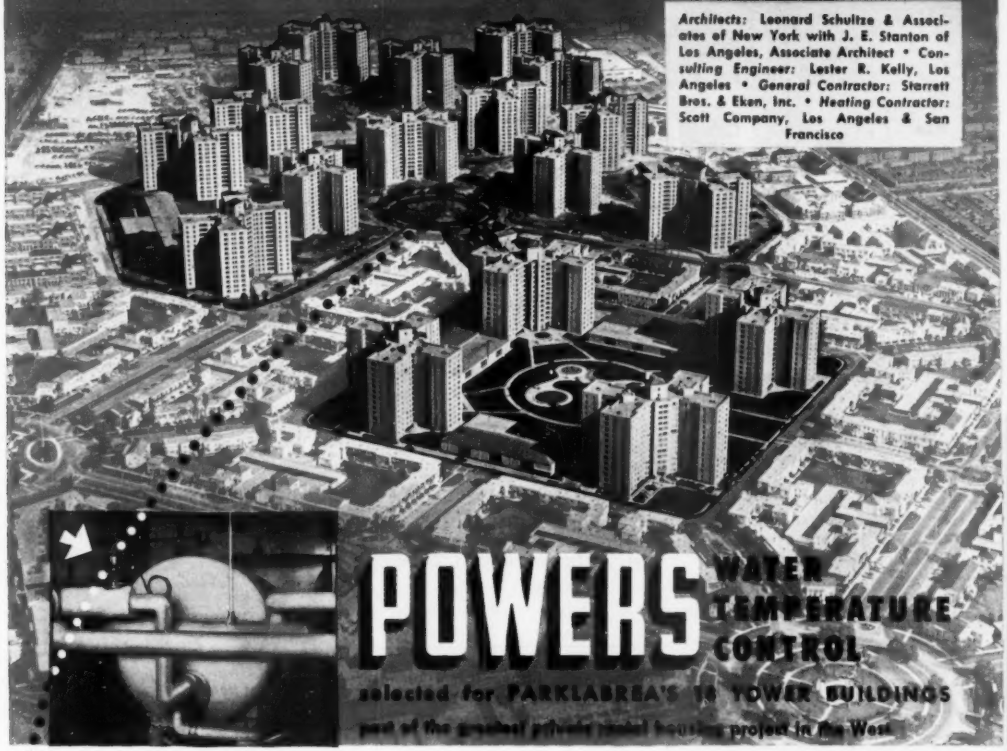
V H VAN DIVER *New York, N. Y.*

Metropolitan Life Insurance Company's

# PARKLABREA TOWERS

Apartments

LOS ANGELES, CAL.



*Architects:* Leonard Schultze & Associates of New York with J. E. Stanton of Los Angeles, Associate Architect • *Consulting Engineer:* Lester R. Kelly, Los Angeles • *General Contractor:* Starrett Bros. & Eken, Inc. • *Heating Contractor:* Scott Company, Los Angeles & San Francisco

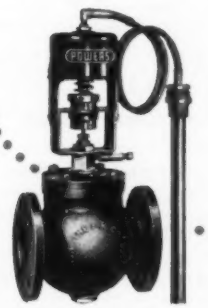


## POWERS WATER TEMPERATURE CONTROL

selected for PARKLABREA'S 18 TOWER BUILDINGS

part of the greatest private rental housing project in the West

***Provides Best Insurance obtainable*** for dependable regulation of domestic hot water storage heaters. Each of the 13 story buildings contains 2 Powers 3″ No. 11 Regulators. They stop hot water complaints by preventing over-heated water. Fuel economies alone often pay back their cost 3 to 6 times a year. Many users report 15 to 25 Years of Reliable Control.




For help in selecting the right type and size regulator for your requirements contact your nearest Powers office. There's no obligation.

THE POWERS REGULATOR COMPANY

POWERS CONTROL 60th ANNIVERSARY 1891 1951

36 POWERS No. 11 Temperature Regulators used in the 18 tower buildings shown above.

Only one of many types of POWERS Control.

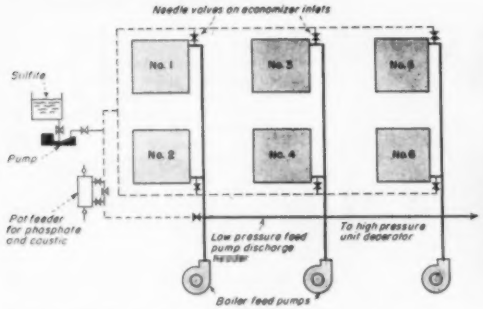
SKOKIE, ILL. • OFFICES IN OVER 50 CITIES

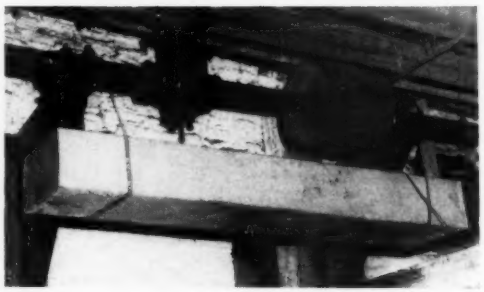
**Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th St. • Los Angeles 5, Cal., 1808 West 8th St. Toronto, Ont., 195 Spadina Ave. • Mexico, D. F., Apartado 63 Bis.**

(a65)

# More PRACTICAL IDEAS

Begins on page 132



## Save Five Pumps

WE FEED CHEMICALS to six boilers by injecting them into feed pump's suction header. A cross connection from the feed pump's discharge header to a new high-pressure deaerator made it necessary to add chemicals to boilers through individual lines. Firm's literature said that in our case we needed one chemical pump for each boiler. They reasoned it was impossible to proportion such small flow even with special valves.

Not wishing to buy a pump and pot feeder for each boiler, we piped up system, using only one pump and one pot feeder for all six boilers.

Continuous flow through ¾-in. line makes it possible to proportion sulfite to different boilers with needle valves at each economizer inlet. Phosphate is shot-fed to single unit or a combination.

This system has been in use some time and it works very well.

C B SHUDER *Grand Tower, Ill.*

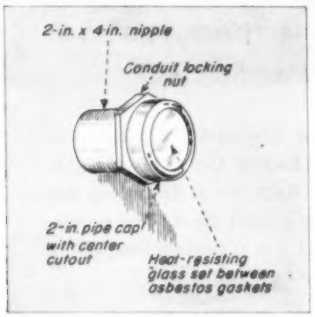
## Oil Catcher Stops Damage

LUBE OIL dropping on clean linen in a laundry brings many complaints. Because our laundry is crowded, every bit of space is used. That's why I had to do something about our dripping shaft hanger bearings.

Oil pan in photo is strong enough to support a man and ladder against it while he is oiling the bearings. The pan's edges are bent inward, and pan is supported by perforated pipe-hanger strips fastened to bearing bolts.

These pans have been worth their weight in gold. They can be used in other places besides laundries.

A L SHEA
*Springfield Gardens, N. Y.*



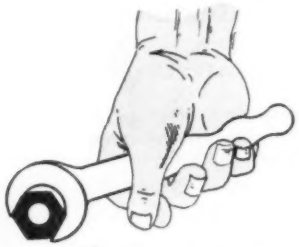

## Look-See for Boiler

FIREMAN AND OPERATORS must be certain ignition isn't lost in the furnace. That's especially true while burning gas, oil, pulverized fuel, or any so-called "suspension fired" fuel, at low boiler ratings.

Usually the boiler furnace has many inspection doors but they must be opened to observe conditions. Many times firemen and operators receive singed hair, eyebrows or burns due to puffbacks from furnace draft, through these doors.

Here's how to meet this problem by adopting one furnace-inspection door near the burner zone. You can see through to observe furnace conditions. Area that can be seen is narrow, but it gives a good picture of conditions. When necessary, clean glasses in door. If set air tight in mountings, they remain clean a long time.

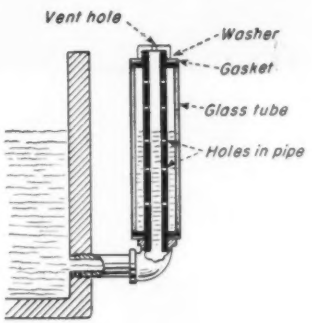
A W SHEPHERD *San Diego, Calif.*



## Nonslip Wrench Handle

GRIND SHALLOW NOTCHES into one or both sides of a wrench handle, as shown. Smooth them with a file or grinding cloth. That gives a grip that is more secure and less likely to slip than if the handle is smooth, specially when your hands are greasy.

T TRAIL *Catonsville, Md.*




## Handy Sight Glass

WHEN THE SIGHT GLASS on our feed pump's turbine bearing broke, we had to replace it in a hurry. From standard fittings, we made the sight glass shown in the sketch.

Any glass tube will do if pipe with drilled holes fits into the glass. Washers and gaskets at glass ends prevent any leakage.

Screw the vented cap down only tight enough to keep liquid in.

E J DUFF *Aurora, Colo.*

# these steam traps won't freeze up!

This outdoor installation of Yarway Traps and Strainers in New Mexico gas plant completely eliminated freeze-ups.

Freeze-ups of outdoor steam traps in winter weather often cause production delays. Don't take that chance . . . especially when it's so easy to install Yarways, the steam traps that *won't freeze up.*

They won't freeze because condensate does not accumulate. The only moving part—a little valve—is continually testing for condensate, discharging it as soon as it forms. There's never anything to freeze.

Other reasons why over 750,000 Yarway Impulse Steam Traps have been sold—they get equipment hotter, sooner; light weight; small size; easy to install and maintain; good for all pressures; made of stainless steel.

More than 200 industrial distributors sell Yarway Traps and Strainers. See your nearest one today. For name, and free 24-page Steam Trap Book, write . . .

**YARNALL-WARING COMPANY**
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

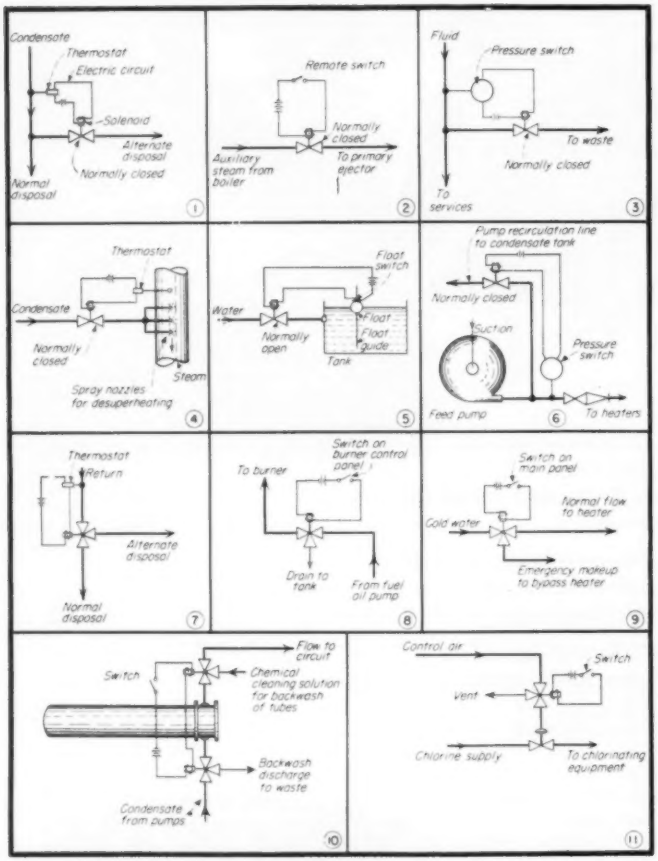
the steam trap designed with more production in mind

# PLANT PROBLEMS ... *put your know-how to work*

## WHERE CAN I USE SOLENOID VALVES?

**HERE ARE THE FACTS: I'm chief of an average-size industrial plant. Recently I came across a bargain in surplus valves and we purchased them for different services. To date we've found one or more uses for every type. But we'd like to check with *Power* readers on the solenoid valves. We intend to use them in refrigeration liquid and cooling-water lines, manufactured-gas lines to process, and for air-compressor relief during starting.**

**It seems to me that an industrial plant of our size, with steam, water, heating, air-conditioning and other services, could use these valves in more places. How and where should we use ⅛- to 2-in., 2- and 3-way valves, rated up to 250 psi?—DP, August *Power***




## HERE ARE THE ANSWERS

**ELEVEN APPLICATIONS.** Solenoid valves are useful for many jobs in almost all piping systems. Install valves with solenoids vertical and on top. Normally-closed valves open when current is applied to coil, close when current flow stops. Normally-open valves close when current flows through coil, open when current flow to the solenoid stops.

Sketches, *left*, show various applications for 2- and 3-way valves in ⅛ to 2 in. sizes. Here's how each works:

(1) Thermostat controls solenoid so when condensate temperature exceeds normal permissible limit, valve is opened for disposal to a higher temperature region. (2) When it is desired to start a priming ejector for a water space from a remote location, a solenoid valve can be used as shown. Remote switch closes circuit to energize coil. (3) For some services a solenoid may be used as a safety valve. When permissible pressure is exceeded the pressure switch closes the circuit to energize solenoid. This opens valve.

(4) With spray-type desuperheaters solenoid valves are useful for controlling condensate flow to spray nozzles. Thermostat or temperature controller energizes solenoid to actuate valve. (5) Control liquid level in a tank with this hookup. When normal level is reached the guided float closes a switch to energize coil and close valve.

(6) A recirculation line is often installed on large-capacity pumps to permit flow of water through pump for warming before start-up, or during low-flow periods to carry away excess heat. Second job, shown in sketch, is done more often. Pressure switch set for a certain minimum pressure operates valve to start and stop circulation. These six illustrations of 2-way valve applications are but a few of the many uses possible.

Three-way valve applications are shown in sketches 7-11. Use as shown or as "food for thought."

(7) This is similar to sketch 1. (8) Good arrangement for oil-burner supply lines. When burner is shut off for any reason the energized coil operates valve, closing intake port and opening drain port, allowing any oil in supply line to burner to flow back to supply tank. This prevents oil dripping into furnace. (9) This valve may be used to bypass a heater or for emergency makeup. (10) Three-way valves in inlet and outlet permit easy backwashing of this low-pressure water heater. Single switch energizes both coils to isolate heater from piping system and connect it to chemical feed line. (11) Here a toxic-gas supply, like chlorine, can be shut off from a remote location. Control valve for chlorine is type that closes when control air pressure fails. Solenoid valve in control air line is energized to open vent port and bleed air from above control-valve diaphragm.

A J Breugelmans *Hoboken, N. J.*

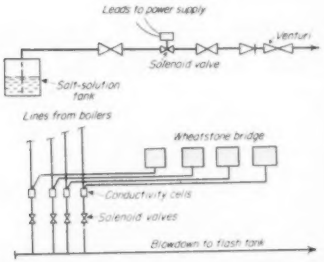
# help the other guy cure his headaches

TYLER HICKS, *Assistant Editor*

**TRY MANUFACTURERS.** There are so many different uses for solenoid valves in the refrigeration field that *DP's* best bet is to write manufacturers. Their catalogs give many detailed uses.

When installing a solenoid valve in a manufactured-gas line be sure orifice is big enough. Valves for this service are often low-tension type fitted with a step-down transformer. Check with your insurance company or local safety inspector before installing the valve.

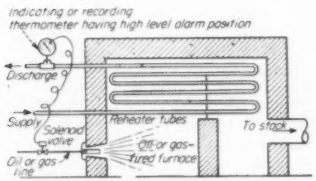
CARL BACHMANN *Rego Park, N. Y.*




**TWO USES.** In top sketch a solenoid valve is used for introducing salt solution into an electric steam generator. Tank holds salt solution. It is fed from here through the solenoid valve to the feedwater line. Opening of solenoid valve is almost instantaneous after switch is closed. This is but one illustration of how a solenoid valve can be used to feed measured quantities of a solution into a vessel by operating a time switch.

Lower sketch shows solenoids used for controlling total solids or chlorides in a boiler drum. Wheatstone bridge is connected to cells immersed in stream of cool water from boiler drum. Valves are actuated when concentration is right.

R A LANE *Three Rivers, Que.*

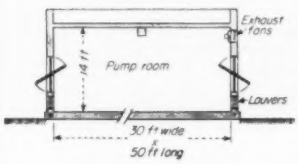


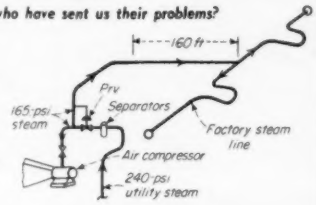

**FOR CRITICAL TEMPERATURES.** Sketch shows solenoid-valve hookup for oil- or gas-fired vessels where exceeding a critical temperature is a hazard. Connect valve to an indicating or recording thermometer that has a high-level alarm. This scheme can be varied.

W A LAWSON *Montreal, Can.*

## YOUR NEW PROBLEMS

*Will you help these two readers who have sent us their problems?*




### 1 How Is Pump Room Ventilated?

**WE'D LIKE to know how much air to exhaust from our pump room to keep inside temperature from rising above 100 F in summer. Air is exhausted by wall fans mounted high in outside wall. Outdoor air is drawn through louvers and windows as in sketch.**

**Pump room houses three steam-turbine-driven pumps and two motor-driven standby units. Total turbine hp is 200; standby motors about 50 hp. Pumping temperatures average 500 F; all pipe is insulated. Turbine and pump casings, however, are bare. Total run of pipe in room is about 200 ft. Operators pass through pump room once an hour and remain only long enough to take log.**

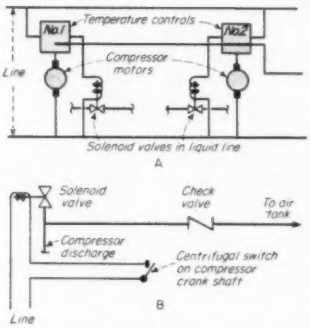
**We'd like info and sketches from *Power* readers on how to keep this room cool.—*CP***

### 2 Why Does Pipeline Vibrate at Times?

**WE HAVE a 6-in. 165-psi steam line running overhead. Supported by flexible hangers, it has expansion bends every 100 ft. At intervals of about 2 min it starts to vibrate, the movement growing in intensity. After a minute vibration stops; then it starts all over again. This has been going on three years, ever since the plant was built. It has us worried.**

**Utility steam comes from pipe below floor as shown. It goes through 165-psi reducer to a large 2-stage air compressor. Beyond the reducer, a line branches to the factory 160 ft away. There it tees into the long overhead line supplying process.**

**We believe vibration is caused by valve action of air compressor transmitted to line. Is that the answer? If so, how can we cure this trouble?—*WB***




**TOPS IN MODERN PLANTS.** Solenoid valves save time, eliminate error and increase efficiency. They may be operated by hand or by a timing device, pressure control, thermostat, air switch.

Simplest hookup has solenoid valve remotely controlled by pushbutton or service switch. Sketch *A* shows solenoid valves controlling start-and-stop refrigeration machines that carry two or more evaporator temperatures. Hookup permits cooling evaporators separately or together. Compressor stops when all rooms have the right temperature.

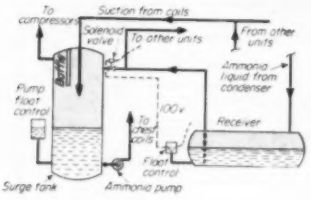
Sketch *B* shows how to relieve an air compressor during starting. Normally-open solenoid valve is fitted to compressor air discharge line. Centrifugally-operated switch on compressor crankshaft energizes solenoid to close valve when unit is up to speed. Install a check valve in air line to storage tank to prevent air loss.

JOHN P MULVEY *Yonkers, N. Y.*

*More PLANT PROBLEMS on page 140*

# More PLANT PROBLEMS

Begins on page 138




**GOOD ON LIQUID LINES.** We use a solenoid valve, as in sketch, in liquid line that is part of our float control for an ammonia refrigeration system. We also use a solenoid valve on the intermediate tank of our system when operating 2-stage. It maintains correct ammonia level. A third use is on our automatic 9x9-in. compressor. Solenoid in water inlet to compressor jacket opens automatically when machine starts.

C R Whittier *Springfield, Mass.*

## MORE ON SETTING UP A WORK SCHEDULE

***Another answer to POWER'S July question***

BOILER OPERATORS

| Days | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F | S | S | M | T | W | T | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-3 | A | A | A | A | A | B | B | B | B | B | B | B | C | C | C | C | C | C | D | D | D | D | D | D | D | A | A | |
| 3-11 | C | C | D | D | D | D | D | D | D | A | A | A | A | A | A | A | B | B | B | B | B | B | B | C | C | C | C | C |
| 11-7 | B | B | B | B | C | C | C | C | C | C | C | D | D | D | D | D | D | D | A | A | A | A | A | A | A | B | B | B |

MECHANICS

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-3 | E | E | - | - | E | E | E | E | E | E | - | - | E | E | E | - | E | E | E | E | - | - | E | E | E | E | E | E |
| 3-11 | F | F | F | - | - | F | F | F | - | F | F | F | F | F | - | F | F | F | F | F | - | - | F | - | F | F | F | F |
| 11-7 | G | - | G | G | G | G | - | - | G | G | G | G | G | - | G | G | G | G | G | - | G | G | G | G | G | G | - | - |

**"SWINGING" SHIFT SCHEDULE.** Up our way we had same problem and worked out the schedule in sketch above. We couldn't set up one suitable for a 40-hr week with "swinging" shifts so we settled on a 42-hr week. Each man works five shifts for three weeks, and six shifts the fourth week. His total is 21 shifts per month. Mechanics have one Sunday off in four because maintenance work is usually done on these days. Pay week starts on Saturday, and ends on Friday.

Vincent Strojsa *Glace Bay, N. S.*

## IS THIS DIESEL ENGINE TIMED RIGHT?

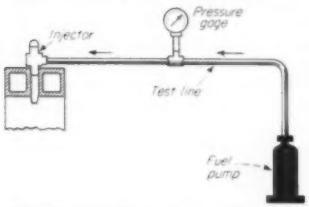
**HERE ARE THE FACTS: We have an 8-cyl 4-cycle 14½x18-in. diesel that develops 665 hp at 300 rpm. Timing of engine valves doesn't agree with builder's. Here's how timing sets up:**

***Builder's:*** **Inlet opens 6 deg btc, closes 14 deg abc; exhaust opens 34 deg bbc, closes 12 deg atc.**

***Actual:*** **Inlet opens 15 deg btc, closes 43 deg abc; exhaust opens 37 deg bbc, closes 15 deg atc.**

**Since inlet valve closes late, aren't we losing some air at start of compression? Other items we need help with are: How can we find piston or flywheel position at time of fuel injection? Can any instrument be used to set fuel cams?—NS, August *Power***

## HERE ARE THE ANSWERS




**LESS CLEAN AIR** is being drawn into engine cylinders. Inlet valve closes 29 deg late, allowing some air to be driven from cylinder. Connect gage to fuel line as in sketch to find injection time on premarked flywheel. Use separate test line for this job. It may be transferred from one cylinder to another.

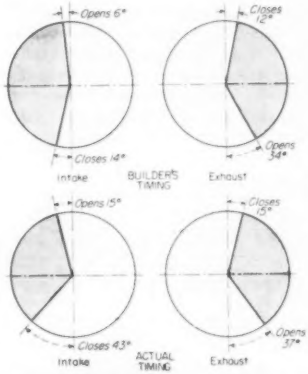
Ronald D Bennett *Hanover, Ont.*

**ACTUAL SETTING OK.** If approximate piston positions are figured at various points in the cycle, engine will run best with *NS*'s settings. I don't believe any air is lost at start of compression. A setting of 8 to 10 deg less might be more desirable but wouldn't make much difference.

Here are several ways of finding time of fuel injection: (1) Loosen fuel line at injector. Turn engine and watch for the instant fuel is forced out of connection. (2) Connect a nozzle to the injection line in such a way that spray can be observed. (3) Since most nozzles are set to open at a predetermined pressure, connecting a gage in fuel line will allow *NS* to watch rise and fall of pressure as injection takes place. Time of injection is point at which gage registers nozzle opening pressure. A stationary pointer over flywheel is needed for all these tests. Pointer should indicate top dead center of cylinder.

Feeler should be good enough for setting fuel cams. Or if engine can be barred over quickly enough, and I believe it can, a dial indicator would work.

Donald Cochrane *Milaga, Minn.*

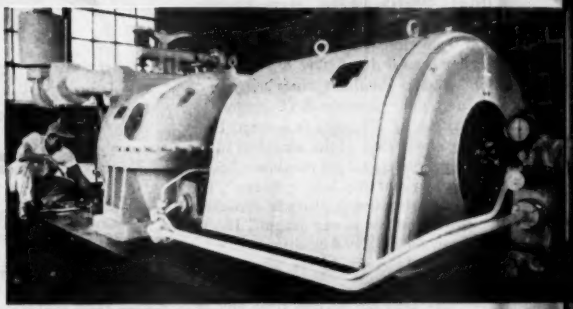



**CHANGE TIMING.** Power is being lost. Delayed closing permits piston to force air out through inlet valve during compression. Amount of air remaining is less than required, so temperature and pressure at end of compression stroke may be lower than engine design condi-

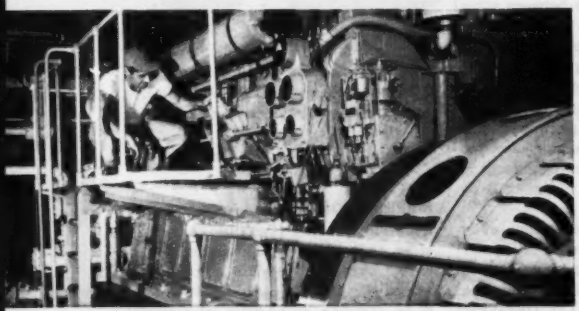
**NANTUCKET ISLAND** can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

# HOW SUN PROTECTS NANTUCKET'S POWER

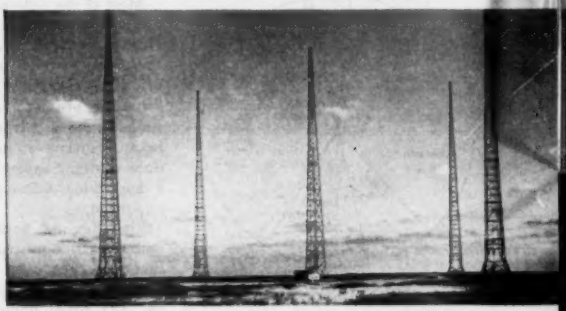
**THE ISLAND'S POPULATION** drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



**DESPITE IDLENESS** for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



**A SUN DIESEL LUBRICANT** has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



**POWER** for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

**For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. P6**

## SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO

Begins on page 138

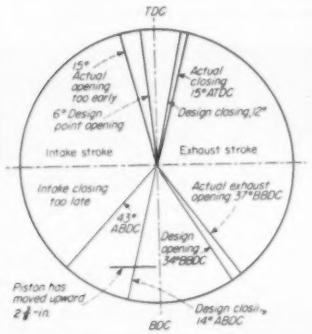
tions. Lower temperature at start of injection means there will be a lag in combustion. Part of the power stroke might be used for combustion or there might be detonation in the cylinder. Delayed exhaust valve closing (by 3 deg) helps because it permits longer purging, leaving a smaller quantity of residual gas.

Change timing to coincide with builder's design. Remember, a diesel engine inducts a fixed quantity of air. When a small amount of fuel is injected into the cylinder not all the air is needed for combustion. But as load increases and more fuel is injected a point may be reached where engine starts to smoke.

A J Breugelmans *Hoboken, N. J.*

**INLET OPENS EARLY.** Actual timing shows inlet valve opens too early. At 300 rpm inlet valve shouldn't open earlier than 8 deg before top dead center. And it shouldn't close more than 15 deg after bottom dead center. If actual timing *NS* gives is correct, he is losing about 13% of the air taken in because piston has moved up almost 2.5 in., forcing air out the inlet passage. Too much air loss at any altitude above sea level may reduce power output. Timing diagram shows piston position.

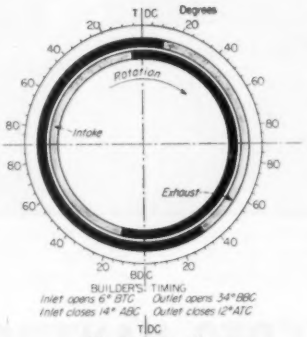
*NS* should check to see what causes this incorrect timing. Possibly the cam gear was removed at one time and incorrectly replaced. Or the direction of engine rotation may have been reversed

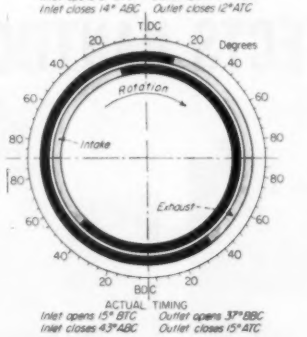



and cams reset improperly. Wear of cams, pins and valve seats causes lost motion and delayed action but not enough to throw valve timing off as much as it is now.

Study manufacturer's instruction book for best way to find exact time of fuel injection. If flywheel isn't marked for valve setting do it at once.

Frank A Butler *Dallas, Tex.*




**WRONG CAMS.** Timing diagram shows that total time *NS's* valves are open is longer than builder specifies. Cam dimensions must differ from those manufacturer based estimates on. Even with correct tappet clearances it will be impossible to adjust valves correctly.

Most of the difference between actual and builder's timing is in intake-valve closing point. As *NS* probably knows, the piston "dwells" longer in lower half of cylinder than in top half. This is caused by piston-rod angularity and will probably be an advantage in his engine because inertia of intake air may produce a slight supercharging effect. So I don't think difference in timing is too important.

Find flywheel position at time of injection by this procedure on solid-injection jerk-type fuel pumps: (1) Set pump in operating position; turn fuel on. (2) Bleed pump. (3) Disconnect fuel-delivery line just behind pump. (4) Crank engine slowly and watch until fuel just starts to rise at pump outlet. This is the beginning of fuel injection in normal operation. (5) Stop cranking engine and note position of crankshaft or flywheel. When making this test, watch direction of rotation to be sure piston is working on compression stroke.

J H W van Aalst *Glendale, Calif.*

**COMPRESSION PRESSURE LOWER.** Power output of engine after a recent overhaul won't be affected by late closing of inlet valve. Though some air is lost there is still an excess to meet combustion needs. But compression pressure is about 85% of design value as a result of late closing of inlet valve. So less compression loss is allowable. This makes worn or sticky rings or leaking valves of more importance than in a properly timed engine. Poor combustion with a loss in power output will develop sooner.

Ignition lag is about 0.001 sec for high-quality fuel and may run to 0.002 sec in some engines. If design of fuel-injection system permits operation with one injector discharging into the atmosphere, you may be able to find cam setting by observing nozzle while engine turns slowly.

Rick A Denning *Bronx, N. Y.*

**CHECK TIMING GEARS.** See that right gear marks coincide. If cam gear is found set ahead two teeth, turn it back one tooth and check fuel cam on pump. Remember, you may have backlash in gears, which will change timing.

R Sid Cadwell *Chicago, Ill.*

**CAM CONTOUR CHANGED.** From data given I'd say cam contour has changed. *NS* should check cams, rollers, bushings, etc, for wear. Replace, if necessary. On some pump-injection systems there are hairlines for checking start of injection. Then some engine builders supply a gage for checking start of injection or cut-off point. Dial test indicator on delivery valve can be used to find approximate point of injection. Use an indicator to set cams and balance firing pressures in cylinders.

A M Damerow *Elk River, Minn.*

**MARINE ENGINE?** Could *NS's* engine be a marine unit with reversible camshaft? If so, that might explain timing difference. Then it's possible someone replaced the original camshaft or altered it by grinding or addition of material to improve engine output. If engine develops rated output and its fuel consumption is within accepted standards, I'd leave well enough alone.

To turn engine over faster I suggest using air-starting equipment. Or *NS* can motorize his alternator or dc generator to drive engine.

Carl Bachmann *Rego Park, N. Y.*

(*Continued on page* 220)

# Whose...

## "EXPERT ADVICE" SHOULD YOU FOLLOW?

With a host of water conditioning "specialists" ready to step in and "solve" your water problems, the job of picking the service best suited for your needs isn't easy. But when you make your selection, consider carefully these three vital factors for successful, economical plant operation:

- A service based on a sound engineering background
- A service with a proven record
- A service backed by ample engineering facilities

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# ARGUMENTS

***Here's the place to unload your gripes to editors, manufacturers and fellow engineers***

—TYLER HICKS, *Assistant Editor*

## Circular-Reading Meter Confusing

WATERWORKS MEN favor circular-reading dials on water meters but in my opinion have no good reason for it. In his article, "How to Read Meters Correctly" (p 48, Feb *OE*), A W Shepherd points out some mistakes in reading these meters. Customers can't read 'em, and meter readers get confused too often.

Once we had a boss who was mighty strong for circular-reading meters. He couldn't see any reason for using a straight-reading dial. We finally asked him how he'd like circular-reading dials on his automobile speedometer. That was a new idea to him and he gave it plenty of thought. Just imagine a traffic cop chasing a car and then having to read circular dials to find speed and mileage!

E A ROBERTS *Hobbs, N. M.*

## How to Cure a Sleepy Fireman

THE REPORT by Arnold Featham and B J McCausey, "Colored Lights Guide Boiler Loading" (p 92, Aug POWER), brought back sweet memories. In 1921, while on the graveyard watch I had much trouble with firemen going to sleep and allowing the boilers to pop off. Conditions became so bad I finally decided to do something about it.

Our maximum pressure was 160 psi. I rigged up several colored lights to indicate boiler pressure. With no lights burning, pressure was between 145 and 150 psi. At 145 psi a white light would go on; at 150 psi a red one, a blue one at 155 psi, and a green light at 158 psi. With this setup I could be almost anywhere in the engine room and know boiler pressure without going over to the main steam gage.

When I put these lights in I couldn't get any lamp coloring so colored crepe paper was used. Remember, this system was rough, but it was before the days of a drop of mercury in a glass tube.

GEORGE G AVANT
*Wilmington, N. C.*

## Don't Throw Away Those Old Instruments

I HAVE a steam-engine indicator and several electrical meters I can no longer use. Rather than sell this equipment for the few dollars it might bring I'd like to present it to someone who can make good use of it. What do you suggest?

CARL BACHMANN *Rego Park, N. Y.*

EDITOR'S NOTE: *The Metropolitan Vocational High School, 43 Oak St., New York, N. Y., has a Liberty ship for training boys for work in marine and stationary plants. The school can always use equipment like this. Send your letter to Bill Paterson, Chief Engineer.*

## Practical Dope on Crankshaft Deflection

OPERATOR'S NOTEBOOK No. 45 (p 110-111, Sept POWER) gives interesting and helpful pictures showing use of strain gages for testing crankshaft deflection. Our company has been using this method for about 28 years.

We'd like to point out a few items that might be improved. The man who discovered the relation between strain and stress was Hooke, not Hook, as given in Fig. 16. Also, last line of Fig. 16 says "The answer is strain in psi on webs." The word "stress" should be substituted for "strain." Strain is usually given in one dimension, never in psi.

Fig. 17 shows a crack that is a typical torsional one. Cracks found where there is excessive fiber stress in cranks are invariably in crankpin or journal fillets. Cracks caused by too much deflection may also occur across crankwebs.

H J VANDER EB
*Hartford Steam Boiler Inspection and Ins Co*
*Hartford, Conn.*

## Doesn't Like Shellac For Handhole Gaskets

STEVE ELONKA was right on the beam when he condemned shellac in Sept Arguments, p 136. I don't even use graphite because without oil it's too messy, takes too long to work in.

For years I've used nothing but commercial Key paste, thinned with water so it can be easily painted on with a brush. What I like best about it is that when you remove plates and covers for boiler inspection, gaskets rip right off without trouble. Besides, gasket surfaces and seats are smooth, don't need scraping or wire-brushing.

In high-pressure boilers bunker C carbonizes. Steam-cylinder oil is better for painting studs, nuts, etc, to stop rust.

ART CANNON
*Laurence Harbor, N. Y.*

## More on Concave-Convex Heads

WE ALWAYS REFER to heads the way they appear to the eye. In other words, as you look at a boiler drum or a tank you see a convex head with pressure on concave side. If pressure is on convex side, we refer to head as you see it, a concave head.

G WELTER *The Bigelow Co, New Haven 3, Conn.*

I THINK convention rules in this case. The average engineer calls an outwardly bumped head convex, and that's it.

F P LANKOW
*The Patterson-Kelly Co, Inc, New York 17, N. Y.*

WHEN TANK has a head that bulges out we say it has a concave head. Head that bulges in is said to be convex. The heads are identical, the only difference being whether concave or convex side faces the pressure. Heads with pressure on concave side may also be called plus heads, with pressure on convex side, minus heads.

W W ABERNATHY
*Black, Sivalls & Bryson, Inc. Kansas City, Mo.*

# CHECK ALL THESE FEATURES . . .

*. . . and you'll appreciate why there are more* **LimiTorque®** *Automatic Valve Controls in use, than all others.*

1. **Micrometer torque seating switch.**
2. **Self contained unit—no gears, nut or bearings to buy.**
3. **Weatherproof, dust-tight and watertight construction.**
4. **Hammerblow device.**
5. **Non-rotating handwheel built into the unit.**
6. **Automatic declutching.**
7. **Motor is disengaged during handwheel operation.**
8. **Can always be declutched for handwheel operation regardless of weather or electrical conditions.**
9. **High torque motors.**
10. **Simple valve yoke.**
11. **May be mounted in any position.**
12. **Three to four times faster handwheel operation.**

This Unit is mounted on top of valve yoke . . . Stem nut is inside and furnished with LimiTorque Unit. Nut is directly inside worm gear which drives it. (All clutches and connecting sleeves are eliminated.)

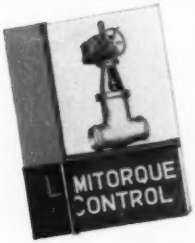
The LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

A special high starting torque motor, reduction gears, limit switches are all in one weatherproof assembly—and all electrical connections are made to terminal boards, easily accessible by removal of watertight cover . . . heat treated helical gears and hardened, ground and polished worm and bronze worm gear are used.

The usual Limitorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.

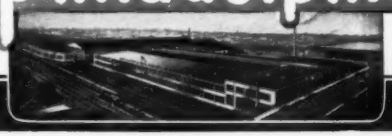
Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided during entire closing operation because motor is shut off by thrust exerted on valve disc.

Actuation may be by any available power source such as electricity, air, oil, gas or water.




**Write for Catalog L-50 for complete details. Please use your Business Letterhead.**

## Philadelphia Gear Works, INC.



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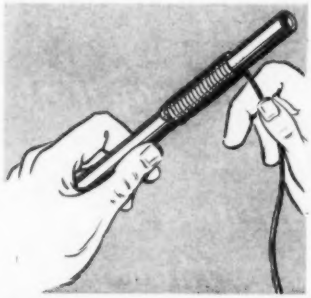
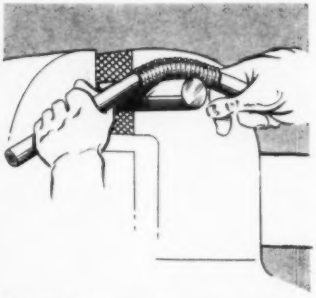
# HOW TO BEND SMALL TUBING RIGHT

By C MORGAN JONES, *New York, N. Y.*

## Wire Wound Around Tube Makes a Neat Bending Job

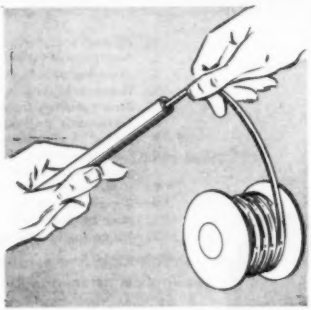


**WIND IRON** or steel wire tightly around the section of tubing that is to be bent

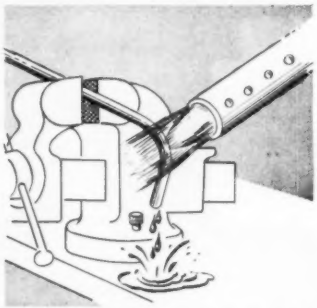


**PLACE A LARGE PIPE** or bar in vise and then bend the tube over it like this

## If Wire Solder Fits Snugly, That Keeps Pipe Round



**BEND VERY SMALL** tubing by inserting a length of solid wire solder inside it



**IF THE WIRE SOLDER** cannot be pulled out, heat the tubes outside with a torch

## Sand for Larger Tubing Holds Job Round at Bend

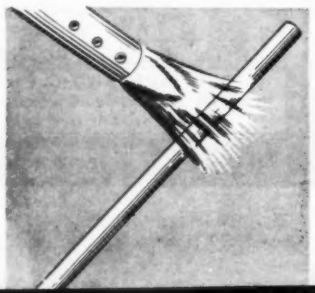
**FILL LARGER TUBING** with pitch (easily removed by melting) or with dry sand

**HAMMER TAPERED** wooden plug into the end of tube to hold tightly packed sand

## Anneal Tubing So It Bends, Doesn't Crack

**ANNEAL THE TUBE** before bending. This is sure way of getting a much neater job

**TO ANNEAL COPPER,** heat to cherry red, dip in water. But cool iron pipe slowly



# ARMSTRONG "BLAST" TRAPS SPEED UP HEATING

*of Single Pipe Coils, On-and-Off Multiple Coils, Unit Heaters, etc.*

IN equipment where large amounts of air accumulate when the steam is turned off, and where the air can be pushed out ahead of the steam, Armstrong "Blast" Traps provide remarkably fast heat-up. A corrosion resistant invar and stainless bi-metal strip holds open a very large vent which lets air whistle right through the trap when equipment or lines are cold. As soon as steam reaches the trap, the bi-metal closes the big vent.

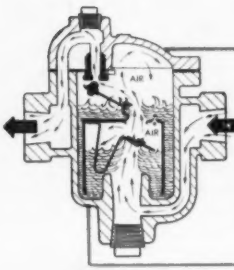
Armstrong Blast Traps combine the benefits of quick heat-up with the dependable service of mechanical traps. There is no bellows to leak or collapse due to high pressure. In fact, the traps are hydraulically tested at 500 lbs. pressure before they leave the factory.

Call your nearby Armstrong Representative for details and prices.

**ARMSTRONG MACHINE WORKS**

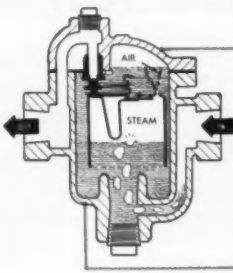
812 Maple Street • Three Rivers, Michigan

*AIR WHISTLES RIGHT THROUGH*




**VENT OPEN**

Note large air bubbles "whistling" through large thermic-control vent to be discharged with condensate through open trap valve. Shaded grey area is condensate.




**VENT CLOSED**

After accumulated air and condensate are discharged, large vent closes. Small vent is always open to handle ordinary volume of air entering trap.

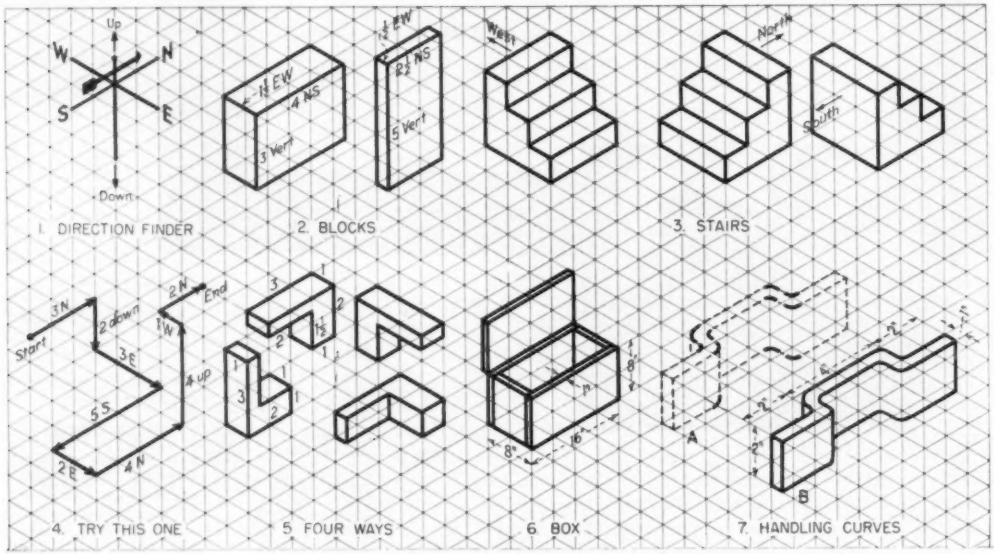
THE ARMSTRONG STEAM TRAP BOOK tells all about Armstrong Blast and Standard Traps—where to use them and how to select and install them. You are welcome to a copy. Just write for it.

SEE OUR CATALOG IN SWEET'S

# ARMSTRONG STEAM TRAPS

# HEADWORK

**PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH**




# *Isometric Sketching-2*

► REVIEWING last month's article, always keep in mind the three main directions on isometric paper. They cover the ruled sheet at the top of this page.

These lines run as follows:

*Vertical lines* correspond to vertical lines in nature.

*Lines slanting one way* (30 deg from the horizontal) correspond to north-south lines in nature.

*Lines slanting the other way* correspond to east-west lines in nature.

You can choose for yourself which slanting lines will be the north-south. Then the other set becomes east-west.

To keep things simple we assume that the object being drawn has square edges (mostly) and is turned until these run in the three prime directions.

***The most important thing in isometric drawing is never to forget which direction you are moving in.*** To keep on the track, why not draw first *each time* the weather vane pictured in Fig. 1. If you take a little extra trouble to draw the arrow and the lettering in true isometric, as shown, that will be good practice too.

As a first exercise in isometric last month, we sketched a lot of blocks in various positions. Here are two more (Fig. 2).

Another good exercise is drawing stairs (Fig. 3). Now try drawing the same stairs upside down.

When sketching a complicated building or piece of machinery it is sometimes convenient to outline it by following the edge around the ground and then up to the roof along the corners. That is exactly equivalent to the practice exercise shown in Fig. 4.

You should be able to duplicate this sketch "sight unseen" starting from the following description in words only: move 3 north, 2 down, 3 east, 5 south, 2 east, 4 north, 4 up, 1 west, 2 north.

Fig. 5 shows four positions of a notched block. Can you figure how to sketch the same block in some of the other 20 possible positions?

Isometric is mighty handy when you want to tell a carpenter how to make you a box (shown in Fig. 6), bookcase, or desk.

If you want a steel strap bent in several places at right angles, you have the makings of a simple isometric sketch except for the curvature at the bends. To handle this case (Fig. 7) first sketch the piece lightly with square corners and put corner curves in free hand (A). Then complete the sketch in solid lines (B). With practice this is very easy. It gives you a picture any blacksmith can follow.

Note the trick in marking dimensions, so that all the dimension lines are part of the same isometric system and look natural.

If you haven't any isometric paper, why not order some now to practice on? Skill in this kind of sketching comes from a lot of spare-time practice—most of which amounts to doodling, and is more fun than work.

You can get 8½x11 punched isometric paper (Form 358-29) from Keuffel and Esser, 1237 Fulton St. New York, N. Y.

# 84,000 lb.

## of ANACONDA Arsenical Admiralty Tubes

## for The Montana Power Company's new steam station

Six thousand and forty lengths of 7/8" O.D. ANACONDA Arsenical Admiralty 439 Tubes in a 37,500-sq.-ft. condenser* serve a 66,000 kw turbo-generator recently installed in The Montana Power Company's new Frank Bird Steam-Electric Generating Plant, at Billings, Montana.

Cooling water from the Yellowstone River will enter the condenser at 65°F. maximum temperature. At this temperature the condenser is rated to remove 460 million Btu per hour from the exhaust steam.

ANACONDA Arsenical Admiralty 439 Tubes are recommended for power and process requirements where corrosion factors are moderately severe, and particularly where dezincification may occur unless prevented by an effective inhibiting agent.

In selecting the most practical and economical tube alloy, there's no substitute for experience with tube performance under the widest variety of operating conditions. The experience of our Technical Department engineers is freely available to you for your condenser and heat-exchanger tube problems. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 43124

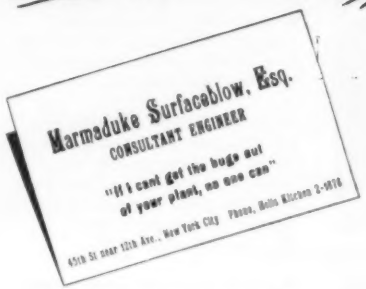
**Designed and built by The Lummus Co.*

*ANACONDA Arsenical Admiralty 439 Tubes being installed in new 37,500-sq.-ft. condenser of The Montana Power Company, Billings, Mont.*

***for efficient heat transfer*** **ANACONDA®**

**CONDENSER TUBES**

The boys and girls whooped and hollered. "Great work," said the manager




# Marmaduke Pulls a Blank

► "WHERE'S Mr. Marmaduke Surfaceblow?" I asked at the Bent Propeller Bar yesterday.

"Haven't you heard?" answered his old shipmate, Bedlam. "Marmy's gone into business for himself. He rented that old office above Mike O'Houlihan's Machine & Engine Works down the street. Wait a minute," he continued, "Marmy left a stack of business cards here only yesterday."

Bedlam looked amongst the bottles on the back bar. He picked up a card near a bottle of Sandpaper Gin.

"Here's one," he announced, handing me a pasteboard the size of a postal card. I read it and, sure enough, the old steam engineer was in business.

I was dumfounded. Two minutes later I climbed the rickety old oil-soaked stairs to the floor above the machine shop. Leather belts were screeching and flapping below and a grinding wheel growled angrily into a casting. What a perfect setting for Marmaduke, I thought, with the Bent Propeller Bar just around the corner and the waterfront two short blocks away. Now the old boy was right at home.

Through an open door from the second-floor hallway I looked into a small musty office. There was our Marmy, feet propped up on a roll-top desk. He was phoning. Some of his waterfront buddies sat around, chewing the fat.

"BILGEWATER ON THAT STUFF," barked Marmaduke into the phone, "IF SHE'S GOT STEAM UP TO HER THROTTLE, I'LL MAKE HER RUN. NOW WHAT'S THAT ADDRESS?"

He scribbled on an old envelope, raising a two-inch draft on his cigar. Then he banged down the receiver. I lowered myself into a corner chair.

"That reminds me of the time I got the chief's job at the old Waldoff Hotel in Detroit, back in 1928," roared Marmaduke, without changing his position.

"My old friend Ed Gleason, now with the Evans Products Co in Plymouth, Mich., put me next to that nightmare. I told Ed I was looking for trouble, and he said I'd find it there. Ed was never more right.

"The Waldoff had been a swanky apartment and transient hotel in its day. But she had passed her popularity and was badly run down at the heels. Her steam plant was in really sad shape.

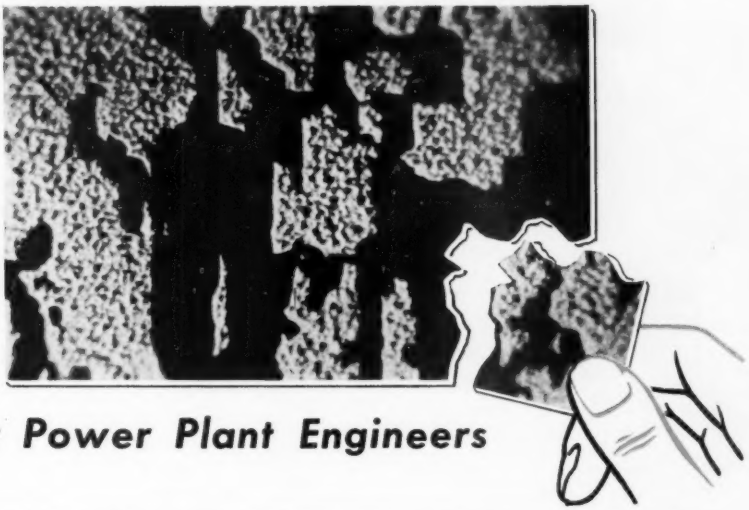
"She had two Hickes cross-drum 150-psi boilers, fired with Excell underfeed stokers. Two Chuse engines were direct-connected to dc generators, serving a 3-wire distribution system with a balancing coil on the neutral. There was the usual ice machinery, elevators and assortment of pumps found in hotel engine rooms.

"But that plant was a mess. Current was bought because those two Chuse engines hadn't turned a rev in years. High-pressure purchased steam sizzled through reducing valves to heat the building. One feed pump was on the blink, one brine pump was snafu, and a vacuum pump was ditto.

"What was the reason for all this?

(*Continued on page* 216)

# JIG-SAW PUZZLE



## for Power Plant Engineers

MAGNESIUM scale, magnified fifty times, can look like the jig-saw puzzle it often represents to plant engineers when it begins to affect boiler operation. Quick solution for this and any other scaling or corrosion problem is The Nalco System for your plant. High quality water treating chemicals, plus expert field and laboratory surveillance assure continuously successful results — now, and in the years to come, as long time Nalco customers will affirm. Write for your no-cost Nalco Water Treatment Survey today.

### NEW DATA ON SCALE IN HIGH PRESSURE BOILERS

**Reprints of "Experimental Studies of Boiler Scale at 2,500 p.s.i.," a paper presented at the 1950 Water Conference of the Engineer's Society of Western Pennsylvania, are available free upon request to Nalco. Article includes numerous photos of scale formations on test boiler tubes, and charts showing results of various water treatment methods.**

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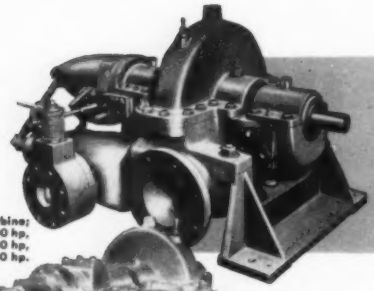
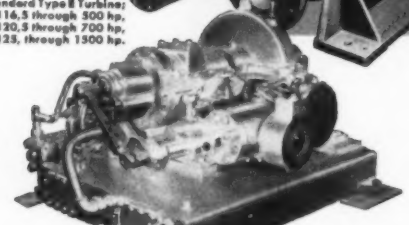
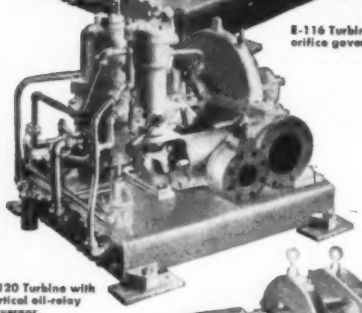
# Take the *Guesswork* out of Turbine Selection!



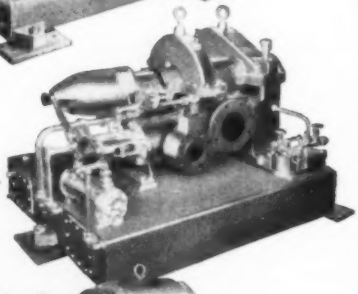
Standard Type E Turbine; E-116, 5 through 500 hp, E-120, 5 through 700 hp, E-125, through 1500 hp.



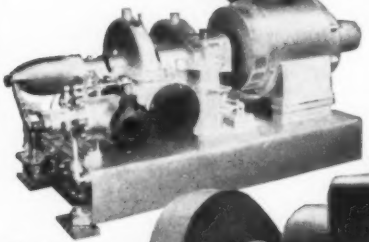
E-116 Turbine with orifice governor.



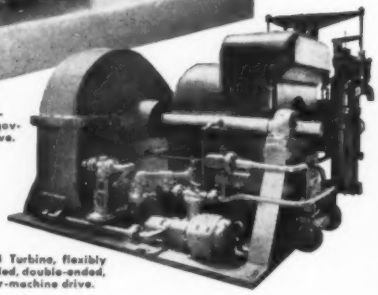
E-120 Turbine with vertical oil-relay governor.



E-116 Turbine, close-coupled gear; shaft governor.



E-120 Turbine, close-coupled gear; shaft governor—generator drive.



M-25 Turbine, flexibly coupled, double-ended, paper-machine drive.

Westinghouse General-Purpose Turbines can be supplied for mechanical or generator drive . . . either direct connected or geared . . . for condensing or noncondensing operation. This *complete* line . . . plus a nationwide staff of trained steam engineers, conveniently located sales offices, and service shops . . . assures you of the correct solution to *your* steam-drive application problem.

The single-stage Type E turbine, with designs for three basic classes of steam conditions, three wheel sizes and three standard governor types, provides in effect twenty-seven *standard, economical* variations to cover a wide range of applications. In addition, an almost limitless number of special applications can be met through the use of heavy-duty parts, and optional accessories.

Geared-turbine drives are offered either flexibly coupled to accommodate either right- or left-hand gear offsets, double-ended output shafts; or close-coupled (Gearturbines). Gearturbines are standardized on a single offset arrangement, affording utmost economy.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring high temperatures and pressures, higher speeds, greater horsepower, extraction for process applications, or higher efficiency than may be had with single-stage machines.

The superiority of the Westinghouse line is the result of over 60-years' design, manufacture, and application experience. To get the benefit of this broad know-how, call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

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THE WADHAMS & MAY COMPANY, HARTFORD, CONN.
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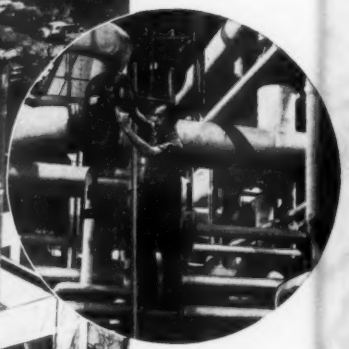
THE LUMSDEN & VAN SICKLE DIVISION
MIDWEST PIPING & SUPPLY CO., INC., BOSTON, MASS.

**To fulfill** its tremendous task of building engines and other aircraft components for defense and civilian needs, United Aircraft Corporation is in an almost continuous state of expansion.

An addition to the power house at the main plant in East Hartford (below) has recently been completed. The $12,000,000 Andrew Willgoos Turbine Laboratory was finished and put in operation on jet research in the past year. Under construction are new plant facilities at the Pratt & Whitney Aircraft Division in North Haven, and the Hamilton Standard Division in Windsor Locks, Conn.

When it comes to plant operation, United Aircraft is right down to earth. To make sure of lasting efficiency and low maintenance in fluid control, they chose Jenkins Valves for all of these new buildings. At the right is a typical valve station in the vast network of piping at the Willgoos Laboratory.

Long a leader in the development and production of piston engines, notably the famed Wasp, the Pratt & Whitney Division is now a major producer of jet engines like the J-48 Turbo Wasp that powers the Navy's new Grumman Panther, shown above.



## United Aircraft Corporation relies on

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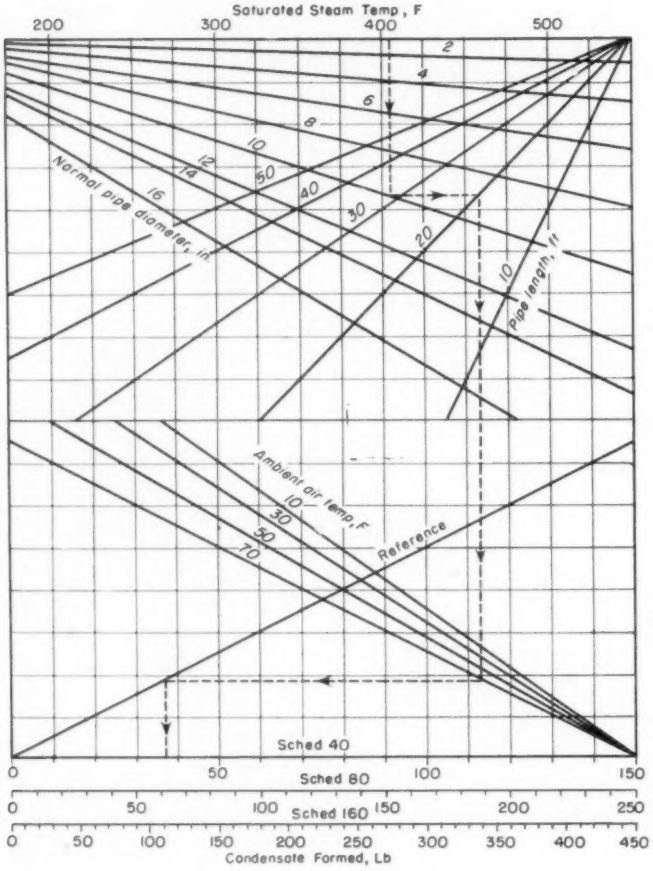
# POWER DATA SHEET

NUMBER 233




## Estimating Warm-Up Condensate

► USE THIS CHART to estimate condensate formed during steam line warm-ups. This must be known to size drip connections and select trap capacities for given lines. Let's see how the chart should be used.

*Example:* A 10-in. schedule-40 steam line in an industrial power plant supplies steam to process units at 260 psia. Line is 20 ft long. How much condensate forms during line warm-up from 70-F ambient room temperature?

From a steam table find saturated steam temperature for 260 psia as 404 F. Enter chart at top at 404 F, follow trace downward to 10-in. pipe diameter, then horizontally to 20-ft pipe length, from here turn downward to 70 F ambient air temperature, horizontally to the reference line, and then down to find the answer on the schedule-40 scale as 37 lb of condensate.

This should be converted to an hourly rate figure. Thus if the warm-up period is 5 min, the condensate forms at the rate of $37 \times 60/5 = 444$ lb per hr. When sizing traps, use the safety factor the manufacturer recommends. If the trap builder advises assuming a radiation load, add this to the condensate figured.

Chart was plotted from the formula:

$$C = W(t_1 - t_2)0.114/L$$

where

$C$ = condensate formed, lb
$W$ = total weight of pipe, lb
$t_1$ = final pipe temperature (steam), F
$t_2$ = initial pipe temperature (air), F
$L$ = latent heat of steam at $t_1$, Btu per lb
0.114 = specific heat of wrought-iron and steel pipe

To make the chart suitable for the three most common pipe schedules, 40, 80 and 160, some approximations were used. Ratio of weight of each schedule pipe to that of schedule 40 was figured for every size from 2 to 16 in. This ratio is not a constant, varying from 1.375 to 1.7 for schedule 80, and from 2.04 to 3.02 for schedule 160. These values would need 16 curves all lying close together. Instead, a value of 1.7 for schedule 80 and 3.02 for schedule 160 was used for finding condensate weight.

For 10-in. pipe and larger, chart values are exact. For the smaller pipe they are slightly high and on the safe side. Schedule 40 values are exact throughout.

T G HICKS, *Assistant Editor*

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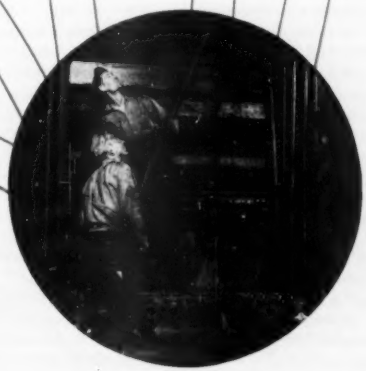
# MORE REST FOR BOILER REPAIRMEN

Boilers last longer, with fewer shutdowns for repairs, when Monsanto Santosite (sodium sulfite anhydrous, technical) goes to work preventing oxygen corrosion. And boiler repairmen take it easy!

Safe, economical, easy-to-use Santosite takes *all* the dissolved oxygen out of boiler feed water, simply by combining with the oxygen to form harmless sodium sulfate. Neither Santosite nor sodium sulfate produces sludge or otherwise harms boilers and piping.

For details on the use of Santosite, supplies of which now are limited, write for a copy of Monsanto Technical Bulletin No. O-26, "*Santosite for Removing Oxygen from Boiler Feed Water*." MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

*Santosite: Reg. U. S. Pat. Off.*



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# READER SERVICE SECTION


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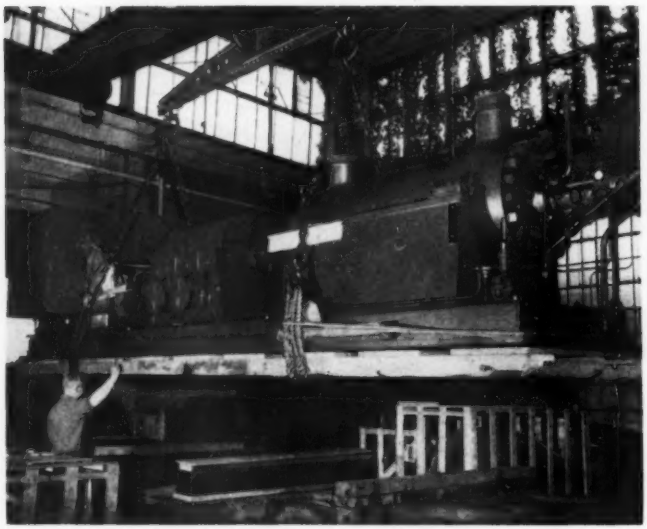


**High-Pressure Pump Gets on Its Way**

Eleven-stage 2040-psi barrel-type high-pressure feed pump for 60,000-kw Danskammer Station of Central Hudson Gas & Electric Co is readied for shipment by trailer truck from the Trenton, N. J., works of De Laval Steam Turbine Co. Pumps are driven by 2000-hp electric motors through American Blower Co fluid drives

## COMING EVENTS

**Nov 1-2—Pennsylvania Electric Assn,** Fort Stanwix Hotel, Johnstown, Pa. E Gordon, chairman, Potomac Edison Co, Hagerstown, Md.

**Nov 5-8—All-Industry Refrigeration and Air-Conditioning Exposition,** Navy Pier, Chicago, Ill. George E Mills, show director, 1346 Connecticut Ave, NW, Washington 6, D. C.

**Nov 15—Boiler Instrumentation Symposium,** Instrument Soc of America, Bellevue-Stratford Hotel, Philadelphia. A W Thorsen, chairman, United Engineers Corp, Philadelphia, Pa.

**Nov 26-29—Canada's Power Show,** Institute of Power Engineers, Royal York Hotel, Toronto, Ont. W G Child, genl secy, IPE, 496 Church St., Toronto.

**Nov 26-30—American Society of Mechanical Engineers,** annual meeting, Chalfonte Haddon Hall, Atlantic City, N. J. O B Schier, secy, ASME, 29 W 39th St, New York 18, N. Y.

**Nov 26-Dec 1—23rd Exposition of Chemical Industries,** Grand Central Palace, New York, N. Y. C F Roth, mgr, International Exposition Co, Grand Central Palace, New York 17.

# Rubber Industry Seeks Open Competition

► THE RUBBER PRODUCTS INDUSTRY is in a unique position among major industries in the U.S., according to John L Collyer, president of B F Goodrich Co. "Government owns the rubber-producing plants, procures the raw materials and schedules production; is the only buyer and importer of crude rubber; determines the amounts of rubber that may be consumed by manufacturers; sets the specifications for the use of rubber; and determines the price."

Collyer wants the President to appoint a special commission to study the problem and develop a policy of competition "in keeping with the traditions and principles underlying our domestic and foreign policies."

At the end of the present emergency the government should take steps to "desocialize" this major industry by selling or leasing to private industry the American rubber plants it now owns, he said. "Socialization of rubber has been tolerated by the American people only because it was dictated by military security and not by a clearly defined policy."

We now have a stockpile of crude rubber to meet military and essential civilian requirements for a 5-year war, and our million-ton-per-year man-made rubber industry has been reactivated, according to Collyer. Government should now schedule the following steps:

1. Terminate control of crude rubber purchasing.

2. Terminate control over civilian consumption of rubber.

3. Accumulate a stockpile of 200,000 long tons of American-made rubber for military security.

4. Limit active government participation in rubber to maintaining strategic stockpiles (after accumulation of the stockpiles).

5. Issue clear-cut policy statement assuring producers and consumers that strategic stockpiles of crude and man-made rubbers will be used only for military and essential civilian security, and will under no circumstances be used to manipulate rubber prices.

Collyer said we should refuse to participate in any international rubber car-

(*Continued on page 228*)

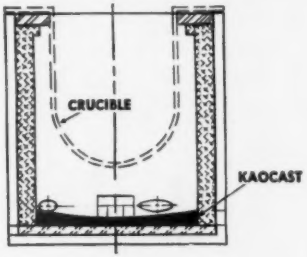
**ENGINEER'S BOOKSHELF ...**

Turn to page 196 for reviews on recent books in the power field. Feature titles this month: *Pump Engineering Data Book, Civil Defense in Modern War, Practical Electricity and Magnetism, Ion Exchange Resins.*

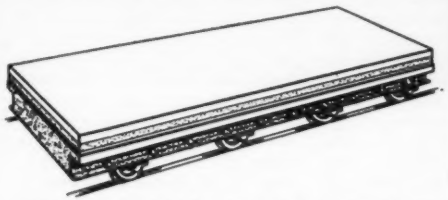
# How you can profit with versatile KAOCAST

Since B&W put Kaocast on the market four years ago, this unique 3000F refractory castable has proved its economy and versatility in scores of high-temperature applications. Look at the capsule case studies on this page. Then consult a B&W Refractories Engineer on your specific requirements and see how Kaocast can save money for you.

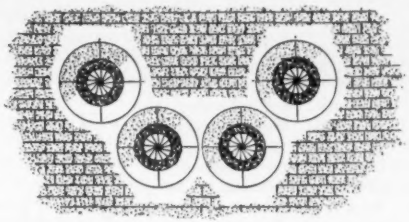
Used to line doors in 15-ton electric furnaces, Kaocast lasted three to four times as long as firebrick . . . cut overall costs in half.




In this magnesium-melting furnace the effect of molten metal previously necessitated replacement of the furnace bottom when the crucible was changed. This is no longer necessary with a lining of Kaocast because it stands up under the intermittent temperatures and has such high spalling resistance.



Kaocast was used for car tops in a ceramic tunnel kiln 150′ long. Ordinary fireclay castables crumbled in only a few trips and required continuous repair, but after 30 trips Kaocast showed no signs of deterioration.



Burner openings in a marine boiler furnace were made of Kaocast. Inspection a year later showed them in such good condition that Kaocast was used for the same application on other ships of the line.

## KAOCAST FACTS

- Versatile Kaocast can be molded quickly and easily with your own labor. It can also be cast directly in place or applied by a cement gun.
- Kaocast eliminates an expensive inventory of special shapes. It speeds repairs and reduces costs.
- Kaocast has high resistance to spalling and slag attack, low volume change and negligible reheat shrinkage.
- Kaocast is available for prompt shipment.
- Kaocast is another example of how B&W sets new standards of performance and economy in the field of high temperature refractories.

**WRITE FOR BULLETIN R-22**

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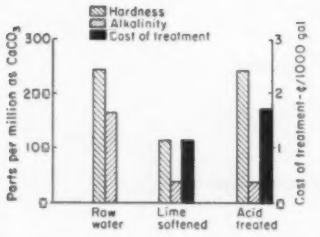
# TECHNICAL BRIEFS

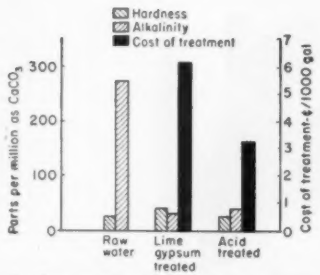
***Latest engineering developments for busy power men***

**12 Digests for you on:**

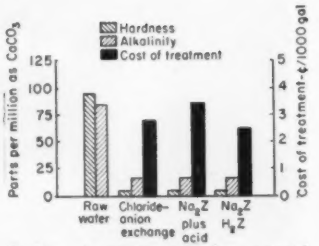
**WATER TREATMENT**
**FUELS AND FIRING**
**INSTRUMENTS**
**GAS ENGINES**




**1** Higher costs, unavailable chemicals require studies of substitute ways




**2** Comparisons shown in these diagrams cover major boiler field treatments




**3** Use of zeolites and other materials can give comparable water results

## Water Treatment

**Meeting Chemical Shortages in Water Treatment.** *By F M Kemmer, Cochrane Corp.*

War and industrial expansion to meet its demands has brought to attention the fact that our general resources cannot be replenished. Sulfur, as an example, is a raw material once considered almost inexhaustible. Sulfur reserve has diminished to where export has been restricted, and alternate methods of producing sulfur and sulfuric acid are being sought. As a result sulfuric acid price keeps going up and will continue to rise. Of more pressing importance, it is becoming difficult to obtain.

Soda ash and caustic soda are also in short supply. Further, the world-wide shortage of fertilizers has pinched the consumer of phosphate reagents. All these chemicals are widely used in the water-treatment field. Plans for substituting other reagents should be considered now.

The author discusses the role these various chemicals play in water-treatment and substitutions for them. For instance, use of lime for alkalinity reduction in the place of sulfuric acid is one method of meeting existing chemical shortages. The advantages of this method are shown graphically in Fig. 1 above. As for soda ash and its traditional role of reducing noncarbonate hardness in boiler feedwater treatment, the author makes the following suggestion: Existing lime-soda softening plants should use partial sodium-zeolite softening to save on soda ash. Fig. 2, 3 show comparisons with other methods. *Combustion, 200 Madison Ave., New York 16, N. Y. Aug. 1951, p. 49-55.*

**Waste Disposal in Great Britain.** *By B A Southgate, Department of Scientific and Industrial Research, London, England.*

Among the factors that govern disposal of industrial-waste waters in Great Britain are: (1) Small size of the rivers and comparatively high density of population and industry; so liquids discharged to inland streams have to be of high quality. (2) Encouragement given to the discharge of industrial wastes to domestic sewers; but since sewage effluents, if discharged to an inland stream, must be of good quality, the industrial wastes may have to receive pretreatment to remove substances that would interfere with efficient operation of sewage-treatment works.

From processes using vegetable matter as raw material, waste waters that are to be discharged to inland streams are frequently treated by biological processes. Examples are the treatment of dairy wastes either by addition of a coagulant, sedimentation, and single biological filtration, or by alternating double filtration; and the treatment of waste waters from cider factories with addition of ammonium salts to give a favorable carbon-nitrogen ratio. Waste waters that are to be discharged to domestic sewers are, if necessary, neutralized, screened, and passed through sedimentation tanks, and may be treated for removal of such constituents as toxic metals, cyanides, chromate and oils. A common difficulty in Great Britain is the disposal of spent gas liquor, much of which is discharged to the domestic sewers. At some works tar is precipitated from the hot gas to reduce the concentration of higher tar acids in the liquor and air is excluded until a late stage of the purification process to reduce the concentration of thiocyanate in the liquor. Some industries have adopted processes of partial treatment, followed by re-use of waste waters. This method is used, for example, in the beet sugar industry and in the retting of flax. *American Chemical Society Paper No. 25, 120th Meeting Abstracts, 1155 Sixteenth St, NW, Washington 6, D.C.*

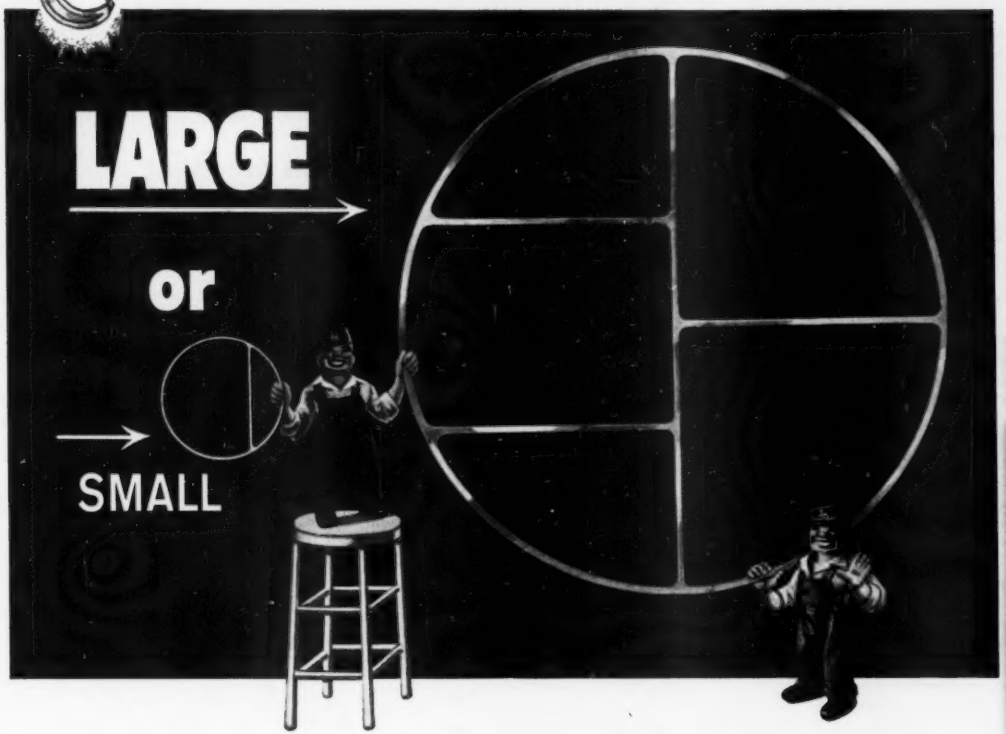
*Directions for ordering papers are given on page 160*

**Some Problems of Waste Processing in the Atomic-Energy Industry.** *By J H Hayner, U.S. Atomic Energy Commission.*

It is a sound policy for any new industry to appraise its operations and plan programs of research and development on the characteristics of the waste products it produces and any environmental hazards it may create.

This is especially true in the newest of all industries: utilization of nuclear energy. Several reasons emphasize this need: Its products have a high hazard potential. Under wartime urgency, research and development were ac-

*Hand-tailored to any size you need...*

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Whether your requirements call for heat exchanger gaskets larger than 100" in diameter, or smaller than 10", you can get the exact size you want . . . hand-tailored to the shape you need . . . simply by specifying "Johns-Manville Goetze."

And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit . . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 290, New York 16, New York.

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**Johns-Manville *Goetze* GASKETS**

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

# More TECHNICAL BRIEFS

Begins on page 158

celerated at a phenomenal rate from laboratory investigation through pilot models to plants of major industrial size. Security restrictions have insulated this industry from the customary observation and supervision by public agencies. Extensive plans are under way for expansion into new and broader fields, where considerations of waste processing and disposal and environmental hazards are most important to national health and security.

Development of atomic energy has brought with it the inherent disagreeable and hazardous problem of disposing of many heretofore practically useless radioactive byproducts. Because of the widely known physiological factors, any commercial application, power source development, and the advancement in general of the science of nuclear energy depends upon the development of satisfactory, safe and economical methods of controlled disposal.

To assist in establishment of these waste sources, there is an identification and classification of their origin—natural materials (ores, etc), fission products (nuclear reactors), and synthetic materials (special irradiations, particle accelerators, X rays, etc. A further subdivision is occasioned by the level of radioactivity and solution type.

A historical review of the development of waste-treatment methods outlines the initial operational activities and the current program of research and development. An early evaluation of the problem was made by those concerned with research of processes and equipment for treatment of wastes. It indicated that there would be no universal process or mechanism which might be a cure-all solution to handling and processing the sources, whether they originate in process, laboratory, or miscellaneous operations.

Final disposition of a radioactive material may take several courses. These courses are indicated together with a somewhat detailed description of methods under study, for the more approved approaches. Various operating problems are recognized for the unit processes or combinations being investigated. Further, the requirements for safe operation that will permit hazard-free disposal are under study.

Limitations and tolerances imposed by requirements for (1) personnel (2) plant safety (3) protection, are imposed as added steps in setting up operating specifications.

Recognition is given to the public health and environmental aspects of atomic-energy operations. Area programs, both AEC and otherwise, must be correlated through the AEC to federal, state, and local departments of health jurisdiction. This will help solve problems involving disposal of liquid radioactive wastes, handling of radioactive materials, and exposure of people and property. *American Chemical Society Paper, No. 24, 120th Meeting Abstracts, 1155 Sixteenth St, NW, Washington 6, D.C.*

**Valves to Combat Corrosion.** *By Jack W Harris, Cameron Iron Works, Inc.*

Confined to handling corrosive products found in gas condensate wells. Since valves are an important element, discussion includes design and metallurgy of valves to combat the effects of this type of corrosion. It is said to result primarily from the presence of $CO_2$, $H_2S$ nascent H, and possibly some hydrogen and brittleness. First solution indicates a proper selection of materials for such service. Second solution would be to render corrosive materials inactive beyond some point in the system, and then determine location of this point so corrosion would be greatly reduced.

Both solutions have been found and specific recommendations, plus equipment, permit inhibitor manufacturers to promise great strides toward improving the design process to further increase the efficiency of results. *ASME paper No. 51-PET-27.*

## TO OBTAIN COMPLETE TEXT

*Material for these abstracts comes from one of the following sources unless otherwise stated. Order complete paper from source, not* POWER.

*American Institute of Electrical Engineers, summer meeting, Royal York Hotel, Toronto, Canada, June 25-29, 1951. Identified by initials AIEE. Obtainable through AIEE, 29 W 39th St, New York 18, N. Y.*

*American Society of Mechanical Engineers, spring meeting, Atlanta, Ga., April 2-5, 1951; identified by initials ASME, SA. Petroleum conference, Mayo Hotel, Tulsa, Okla., Sept 24-26, 1951; identified by initials ASME, PET. Fall meeting, Radisson Hotel, Minneapolis, Minn. Identified by initials ASME, F. Obtainable through ASME, 29 W 39th St, New York 18, N. Y.*

*National Electronics Conference, annual meeting, Edgewater Beach Hotel, Chicago, Ill. Oct 22-24, 1951. Identified by initials NEC. Obtainable in Proceedings, Volume 7, $5 from the NEC, 852 E 83rd St, Chicago 19, Ill.*

## Fuels and Firing

**Operation of Power Boilers With Lignite Coals.** *By J W Hoffman, Northern State Power Co, and John M Dravelle, Iowa Electric Light and Power Co.*

A number of factors are working toward the development of coal from Canada and northern U.S. Chief among these are the westward movement of industry, the rapid development of central-station power requirements, the changing cost picture of Eastern or dock coals, and the rapidly increasing price of competitive fuels. Lignite is basically a high inherent-moisture coal (30-40%) relatively low in Btu. Because of these conditions and the present freight rates, it is not shipped much farther than 200 to 400 miles, and so it is a local-area fuel.

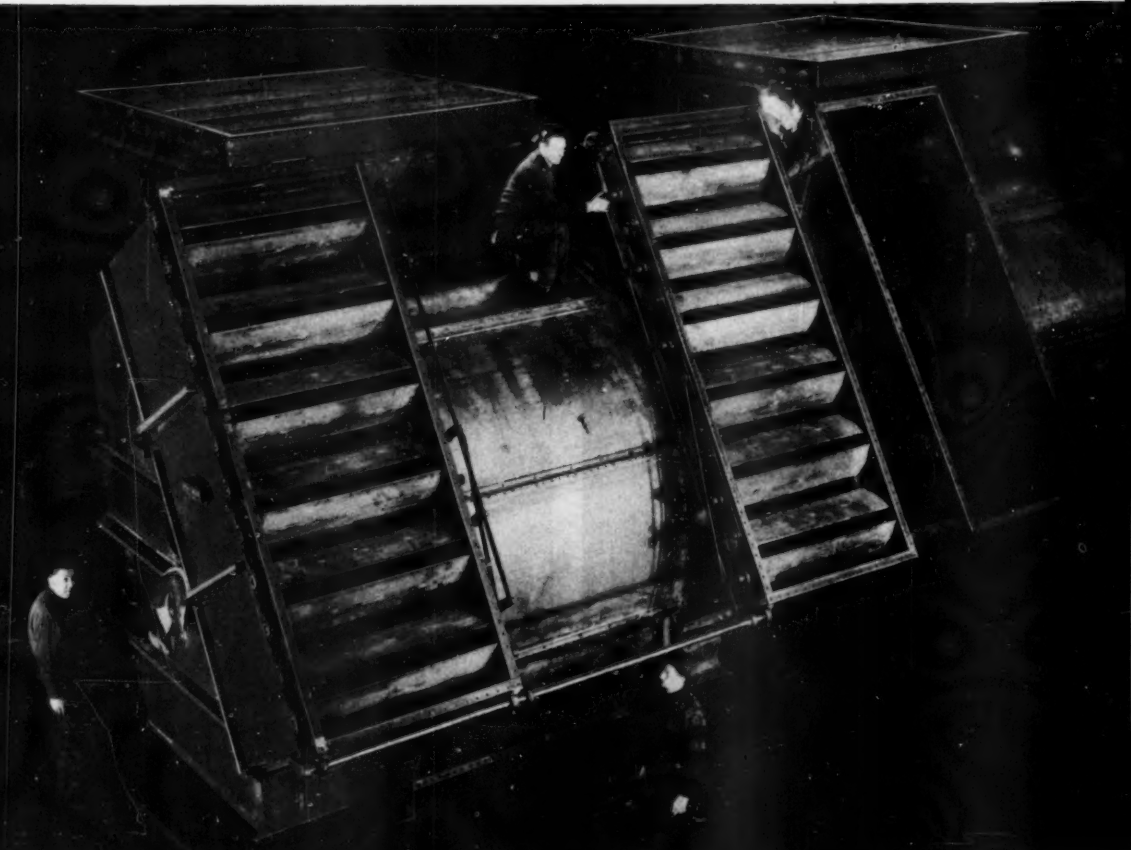
To obtain a cross section of current design practice for boilers of 50,000 lb per hr and larger, the authors sent questionnaires to major utility and industrial users of lignite in the area affected. All installations reporting are using preheated air. Although the average temperature is slightly over 350 F, latest installations are above this and indicate a trend toward 400 F. More recent stoker-fired installations have waterwalls on all four sides of furnace, and spacing has been reduced to 6- to 7-in. centers or less.

The relatively large quantity of flyash and low combustible content of the ash does not make reinjection attractive. All but three of the reporting stoker fire installations are using overfire air. Although this is beneficial in the control of superheat, it is probably not as essential as turbulence is with higher carbon fuels. Lignite on reaching combustion temperatures explodes to give a very intimate mixture of air, water vapor and volatiles.

Because of the high inherent moisture content, a large amount of highly superheated steam, along with the gases of combustion, are released within the furnace. Result is an unusually high mass flow of gas through, first, superheater of the boiler, then the convection section, air preheater and economizer where used. This high mass flow across

(*Continued on page* 222)

# Big Reason For Cheap Electricity!



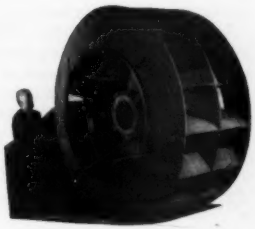
## "Buffalo" Induced Draft Fan - -

one of six built for prominent power company. 16′ 2″ high, it has a rated capacity of 202,500 cubic feet a minute against 15″ static pressure. In service, a continual storm of fly ash will pass through this fan. That's why "Buffalo" builds Induced Draft Fans ruggedly — to stand power plant service the maximum time without repairs or shutdowns. And that means lower power costs! Note "Buffalo" Paraflow Dampers on inlets and outlet for accurate draft control.

## Big Wheel in the Power Industry!

At right, the 12½ ft. wheel for the fan shown above. Note heavy plate construction with welded-on wearing strips on blades. The wheel takes the beating in draft work—that's why "Buffalo" wheels are TOUGH!

*WRITE FOR FACTS!* Dependable draft is a fundamental way to keep power costs down. Pick "Buffalo" Forced and Induced Draft Fans and be sure! Write for Bulletins 3750 for all the facts.



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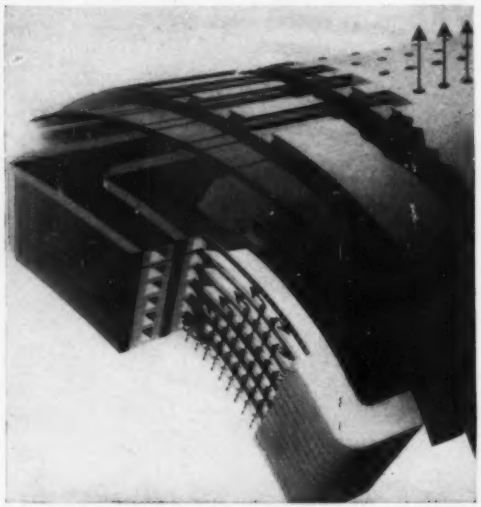
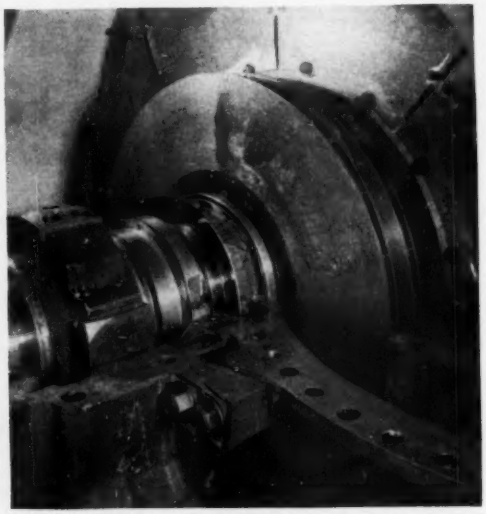


**WESTINGHOUSE** generator rotor uses hollow conductors to transmit heat direct from copper to hydrogen passing through



**ALLIS-CHALMERS** 60,000-kw generator uses two-stage centrifugal compressor to force hydrogen through rotor passages

## Improved Hydrogen Cooling Ups Generator Ratings

### HOW WESTINGHOUSE DOES IT . . .

► A METHOD of cooling central-station generators developed by Westinghouse Electric Corp makes it possible to increase capacities by as much as one half. Cooling arrangement blows hydrogen gas at high velocity through specially constructed, hollow generator coils. This brings hydrogen in direct contact with the heated copper and reduces heat flow through coil insulation almost to zero.

Heat transfer coefficient from copper to hydrogen and incoming hydrogen temperature determine coil temperature. For given maximum temperature rise it will be possible to pass more current through the coils. The additional heat can be dissipated quickly through the direct contact.

Internal cooling is particularly suited for capacities of 90,000 kw and above. Much higher capacities are now possible than with conventional hydrogen cooling. Up to 275,000 kw now seems possible at power factors and stability characteristics suitable for large systems.

Increase in copper losses from higher current densities is more than offset by smaller bearing losses and reduced rotor-surface losses. Radial length of the air gap increases markedly while rotor surface decreases.

Reduction in physical size conserves two critical materials, copper and steel. Higher costs per unit weight offset savings realized by smaller copper and steel needs. Large capacity generators of this type should lower over-all station and

*Continued on page 164*

### HOW ALLIS-CHALMERS DOES IT . . .

► ALLIS-CHALMERS announces the installation of the world's first "supercharged" generator at the Edgewater plant of the Wisconsin Power and Light Co in Sheboygan, Wis. Unit was installed in midsummer and is now running. Its design uses principles that save up to 40% of the material of a conventional generator.

Reduction of weight and length in the 60,000-kw 12,500-v 3600-rpm generator comes from forcing hydrogen at high velocity directly over the surfaces of the conductors in the rotor. Hydrogen circulating velocity greatly exceeds that used in conventionally designed machines.

In addition to the normal fans for circulating hydrogen, the new generator has a 2-stage centrifugal compressor mounted on one end of the rotor. This forces the hydrogen through the rotor passages. Specially shaped copper windings permit direct transfer of heat from metal to hydrogen. After leaving the rotor the heated hydrogen is cooled in conventional water-to-hydrogen heat exchangers.

Cooling gas from the main gas circuit of the generator enters the supercharger (or blower) at a point just ahead of the usual stator cooling fan. After compression the gas passes through one end of two of the four main coolers and then enters each end of the rotor. Because of the small amount of gas needed for rotor cooling it pays to drop its temperature well below the 40 C used for the stator. Chief reason

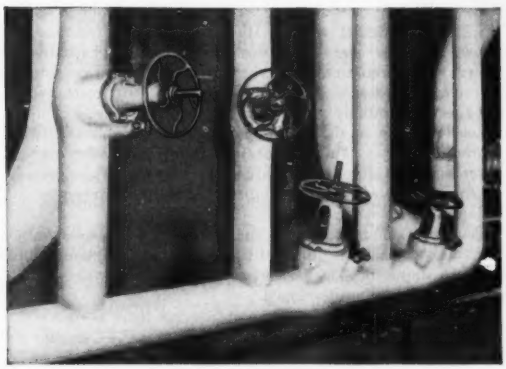
*Continued on page 164*

# a better gate valve for 600-pound services ...CRANE pressure-seal bonnet design

Better—because these Crane valves completely eliminate bonnet joint maintenance. And because they assure power plants—industrial and utility—ideal flow conditions, with many added cost-reducing advantages.

For instance, they save on erection and suspension costs, because, size for size, Crane Pressure-Seal Bonnet Gates are much lighter in weight and more compact than flanged bonnet steel valves. Insulating Pressure-Seal valves takes less time and materials because of streamline contouring.

For complete information about Crane 600-Pound Pressure-Seal Bonnet Gates—also companion lines of 900 and 1500-Pound Gates, Globes, Angles, and Stop-Checks—send for Circular Ad-1819, or ask your Crane Representative for a copy.



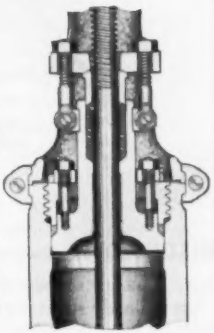
Boiler feedwater header in central station. No danger of bonnet-joint leakage; valves are Crane Pressure-Seal Bonnet Gates.

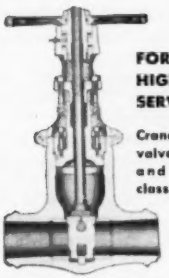
Patented and Patents Pending

600-Pound Butt Welding Gate for temperatures up to 1000° F. max.

**NO BONNET-JOINT LEAKAGE OR MAINTENANCE**

Bonnet joint is inside the valve, sealed with a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of bonnet, forces bonnet against seal ring and wedges it between the body and bonnet to form a pressure-tight metal-to-metal joint. Since pressure tightness does not depend on bolting, no periodic restressing of bonnet joint is needed.





**FOR HIGH-PRESSURE HIGH-TEMPERATURE SERVICES**

Crane Pressure-Seal Bonnet Gate valves are also available in 900 and 1500-Pound pressure classes.

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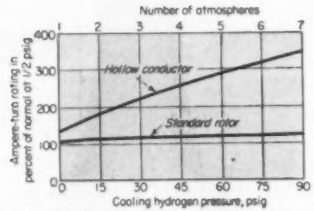
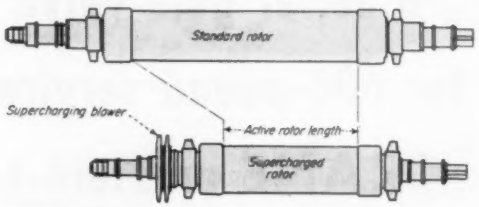
# More EQUIPMENT NEWS

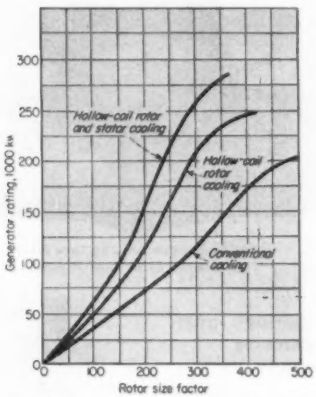
Begins on page 162



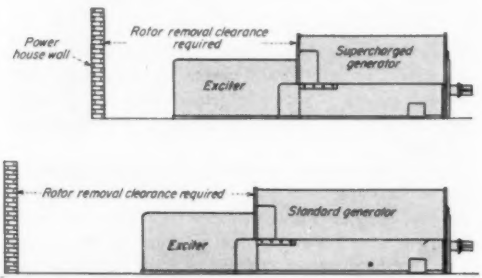

**RAISING** hydrogen pressure ups ampere-turn rating of hollow-conductor rotors




**SUPERCHARGED** cooling shortens rotor length for same capacity which reduces balancing problems, especially at high speeds




**GIVEN** rotor sizes produce more output as the rotor, then the stator are cooled




**SHORTER ROTOR LENGTH** reduces size of entire unit, here's comparison of old and new 60,000-kw units, reduction over 9 ft

## WESTINGHOUSE *Continued from page 162*

operating costs without sacrificing efficiency performance.

Curves in the upper graph (above) show rotor ampere-turns per slot, with average and maximum copper temperatures the same for both types of construction. In the standard rotor, hydrogen comes in contact with only the outer insulated surface of the generator coils. Increased hydrogen pressure offers very little increase in rating.

With internal cooling, increased hydrogen pressure pays off with much greater capacity. This makes possible the building of very large generators.

At present the inner-cooled stator coil has not been developed to the same stage as the rotor coil. It may be advisable to apply internal cooling in two steps for (1) the rotor alone (2) rotor and stator together. Advantages of inner cooling are basically associated with high hydrogen pressures. High-pressure blowers are needed in the generator to circulate the gas through internal ducts.

Lower graph shows what can be expected for kw ratings based on 0.85 pf and 0.8 scr (short-circuit ratio) using 30-psig hydrogen pressure. No changes have been made in flux densities in stator and rotor portions of the magnetic circuit.

Two 3600-rpm generators rated at 175,000 and 200,000 kw will be completed in 1954. A 90,000-kw unit with both stator and rotor internal cooling is now being designed and expected to be available for full-scale testing in latter part of 1952.

## ALLIS-CHALMERS *Continued from page 162*

for extra cooling of rotor gas is to maintain usual emergency rating with air instead of hydrogen.

Reactance characteristics of supercharged generators are better than conventional ones. Higher subtransient reactance allows using breakers with smaller interrupting capacity. Short circuit torques reduce so they no longer hamper bearing and coupling design. Unsaturated synchronous reactance remains substantially unaffected by increased rating. Increased air gap in the new design maintains the standard short-circuit ratio. This increase and higher saturation give lower effective saturated synchronous reactance. This gives an equivalent steady state stability of a higher short-circuit ratio machine.

Coolers, frame bearings and end covers are the same as in conventional machines. Shorter lengths of rotor and over-all unit are shown in sketches above. Ratings other than the 60,000 kw are being developed.

In addition to smaller space requirements there are other advantages: (1) higher fractional load efficiency (2) smaller foundations (3) smaller cranes (4) smaller generator bearings and hydrogen seals (5) greater overload rating of rotor at higher gas pressures (6) higher critical speeds with reduced balance problems (7) ability to ship larger machines completely assembled and tested.

Change from air to hydrogen cooling introduced about 16 years ago boosted ratings by about 20 to 30% for given frame sizes. Supercharged cooling raises ratings by an additional 70% in one step without increasing material required. Future developments may well increase this gain.

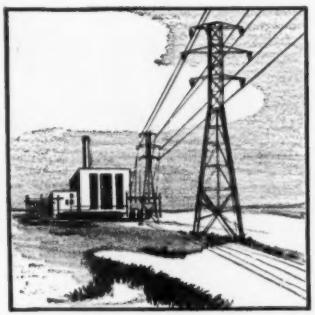
*More EQUIPMENT NEWS on page 166*

# BUSINESS IN MOTION

## *To our Colleagues in American Business . . .*

Like other suppliers, Revere offers its metals in a wide variety of alloys. This is for the reason that no one metal or alloy is suitable for every purpose, for every requirement. In order to help solve the sometimes complex problems that arise concerning metal specification, fabrication, and use, Revere offers the services of its Technical Advisory Staff. Here is an example of its work.

When an electric utility was re-tubing a condenser, Revere Research had an opportunity to obtain samples of the tubes that were removed. A laboratory examination showed them to be made of an excellent alloy; let us call it "Alloy X," since the tubes were made by a competitor. This alloy is usually specified for conditions of erosion-corrosion, but our examination indicated that the tubes also were subject to severe attack by air entrainment and high-velocity, turbulent water. The Revere Technical Advisor, who inspected the condenser in person, suggested that longer tube life might be obtained if cupro-nickel in the 10% nickel alloy were used. As a test, 50 such tubes were installed alongside the new "Alloy X" tubes.



At the end of only three months, the utility was disturbed to find that some of the "Alloy X" tubes were beginning to fail. Samples were sent to Revere Research, which once again reported that these competitive tubes were good ones, mechanically and as to alloy. The Revere Technical Advisor immediately returned to the utility, where he spent two days and nights on the job, much of the time inside the condenser itself. He found the cupro-nickel tubes in fine condition. Recommendations included putting a perforated iron sheet in the water box to reduce turbulence and air entrainment, and the use of 10% cupro-nickel tubes throughout. These suggestions were followed.

Two years later the cupro-nickel tubes were inspected, and found to be in excellent condition. As a result, a new generating station of the company was equipped with them.

Please note our statement that the tubes made by a competitor were all right as tubes. If Revere Tubes in the same alloy had been installed there, the same trouble would have been experienced. It was natural enough for the utility to blame the tubes, but Revere knows that if condenser tubes do not give long and economical service the fault most probably lies in the selection of an alloy unsuitable for operating conditions. In many cases, as in this one, Revere has been able to suggest changes in alloy or in operation, or both, bringing about important economies for users of condensers.

What Revere does in this way is not unique by any means. Suppliers in every industry do as much for their prospects and customers, every day in the week. They do it gladly, because a happy, satisfied customer is a precious asset. So we suggest that no matter what your business is, no matter what you buy, nor from whom, you take your suppliers into the closest possible confidence, permitting them to learn all they can about the conditions their materials have to meet. This will cost you nothing, and may save you much.

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# More EQUIPMENT NEWS

Begins on page 162

**PROCESS CONTROL** **P1110**

Sensitive, instantaneous and accurate control of flow, temperature, pressure, liquid level by *Tel-O-Set* controller. Latest addition to series that now includes differential converter, *Tel-O-Set* indicator and recorder. Operates on pneumatic balance principle. Comes in two types, one with fixed proportional band, other with adjustable proportional band.

**Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.**

**TRANSFORMER WELDER** **P1113**

Rugged, easy to operate, *Airco* Model MCM, 200 amp transformer-welder gives good service in general maintenance. Two open circuits, 80 v on low range and 55 on high. Combines easy arc starting with lower kva demand load and primary ampere current.

**Air Reduction Co, 60 E 42nd St, New York 17, N. Y.**

**SCREW VISE** **P1108**

Round, tapered or irregular objects are clamped in the *Sevo* vise. Jaws consist of a series of machined and ground-flat plates. Hinge or swivel in any direction to fit shape of object held. Jaws can move in relation to one another so work piece may rest on a contact surface underneath. Distance between them is 2½ and 5 in. in two sizes.

**De Wilde-Jones, Inc, 181 Stewart St, San Francisco 5, Calif.**

**FIRE EXTINGUISHER** **P1114**

Positive, one-hand operation features the *Redi-Grip* pressurized, portable fire extinguisher. Available in 1, 2½ and 4-qt sizes with choice of charges—chlorobromomethane (CBM) or carbon tetrachloride, individually or in combination. Expellant may be either air or carbon dioxide. Range is 30 ft; discharge time for one-quart size is 27 sec at 70 F.

**Stop-Fire, Inc, 125 Ashland Place, Brooklyn 1, N. Y.**

**OIL ADDITIVE** **P1106**

Clogged filter screens in domestic oil-burning systems and commercial diesels, and fouled diesel fuel-injector parts are a thing of the past, according to the manufacturers of *Ionad 17*, a fuel-oil additive. This is said to be stable, noncorrosive, easy to use. Treatment required by refiner is claimed to be less severe and sludge accumulations in storage tanks are much reduced.

**Shell Chemical Corp, 50 W. 50th St, New York 20, N. Y.**

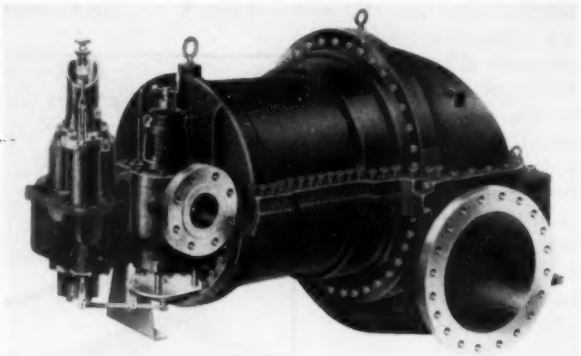
*For more data on these items, use post cards, p171. Identify request with P and number.*

**TOMORROW . . . TRANSFORMERS COOLED BY VAPORS**

Vapor-cooled, vapor-insulated transformer about 1/3 lighter than conventional liquid-immersed units is on its way. Research laboratories of Westinghouse Electric Co have come up with new cooling technique that uses heat of vaporization of liquid fluorocarbons for cooling and dielectric strength of the same fluorocarbon vapor for insulating.

High-molecular-weight fluorocarbons are new family of synthetic compounds; simply sprayed on transformer core and coils. Fluorocarbons show great promise for vaporization cooling for two reasons: They have (1) suitable boiling point and heat of vaporization (2) high dielectric strength. In fact, the 60-cycle dielectric strength of fluorocarbons in a reasonably uniform field, at atmospheric pressure, is greater than that of transformer oil.

At present a network transformer is being designed for installation by Consolidated Edison Co of New York City. Where will they be used in the future? Where (1) safety is required beyond that of liquid-immersed transformers (2) space and voltage limitations rule out the dry-type (3) extremely compact installation with forced external cooling is needed.



**MULTISTAGE MECHANICAL-DRIVE STEAM-TURBINES** **P1121**

Designated as Types DP, DR, DRV and DRVX, new turbine units rated from 200 to 5000 hp cover wide range of industrial applications and power-generation purposes. Type DP, rated from 200 to 3000 hp, drives pumps, compressors, fans, blowers and similar equipment. Equipped with hydraulic governor for 30% regulation.

Type DR, rated from 200- to 5000-hp, supplies wider speed range, greater accuracy of control, and greater capacity than Type DP turbine. Oil-relayed governor on Type DR provides speed range up to 6 to 1, with only 4% regulation and 0.5% steady-state speed variation.

Type DRV, rated from 200- to 5000-hp, has governing characteristics of the DR multistage turbine, but while DR unit employs single-governor controlled valve, the DRV uses automatic sectional valves linked to oil relay governor. Minimizes throttling losses under fluctuating load factors and improves over-all heat-cycle efficiency.

Type DRVX provides process steam at a definite, steady pressure. Steam is extracted from one intermediate stage of turbine at pressure that is held constant even when load on unit fluctuates, and flow of extracted steam varies. Exhaust steam may be condensed or applied to process needs along with extracted steam.

**General Electric Co, Schenectady 5.**

**END-LOCKING PISTON RING** **P1127**

One-piece *Sealock* piston ring has feature that locks one ring end "in" tightly against the other. Locked end is prevented from expanding into ports in a cylinder wall. Suitable for 2- and 4-cycle engines. Seals against compression blowby.

**Double Seal Ring Co, 2065 Montgomery St, Fort Worth 1, Texas.**

**PLASTIC SEALER** **P1105**

*Graycote*, a compound for sealing gaskets and threaded joints of all types, is composed of six basic ingredients, chief of which is a spongy metallic pigment locked in a new type of insoluble vehicle. Retention in the nondrying vehicle keeps the compound soft, creating a permanent seal but allowing units to be easily disassembled

# instantaneous *all-electronic control*

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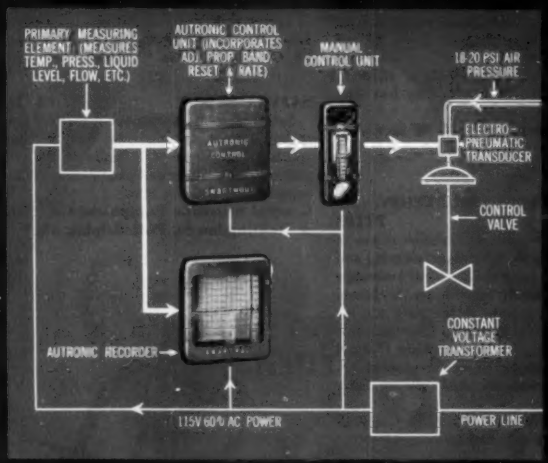
and level . . .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The new Swartwout Autronic Control System brings new speed, new accuracy to your process controls. Without mechanical motion of any kind this new *all-electronic control system* spans distance between primary element and control element *without interval*. Measuring . . . analyzing . . . correcting —the Autronic System keeps your process on stream . . . assures quality product by controlling pressure, temperature, flow and level properly, instantaneously *without cycling, drifting, shifting.* Call in our engineering representative to explain how Swartwout Autronic Controls will bring new accuracy to *your* process and power instrumentation and control. Or write *today* for literature on the new Swartwout Autronic Control System.

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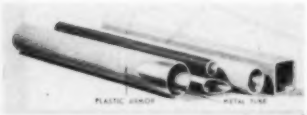
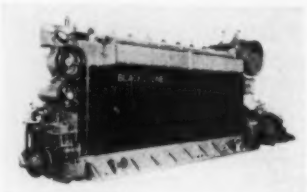
Begins on page 162

after long periods, even under high-temperature conditions. Sealer is recommended for all oil, water, steam, gaseous-fuel and refrigerant applications.
**Chicago Gasket Co, 1275 W. North Ave, Chicago 22, Ill.**



### PLASTIC-ARMORED TUBING P1116

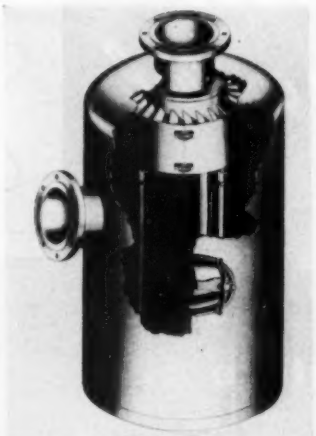
Made in large variety of sizes, *Dekoron* tubing is used for industrial instrument lines and electrical conduit. It consists of welded or seamless tubing armored with vinyl or polyethylene plastic. Many colors and finishes. Tubing won't crack, chip, peel or flake. It resists corrosion from salt air, moisture, oils, acids and alkalies, and is unaffected by normal temperature changes. Tubing is warm to touch, free from static electric shock, and can be given any desired dielectric properties.
**Samuel Moore & Co, Dekoron Tubing Div, Mantua, Ohio.**



### STATIONARY DIESELS P1126

Series EV engines are available in models with 2, 3, 4, 5, 6 and 8 cylinders, developing 90, 135, 180, 225, 270 and 360 hp at 600 rpm. Turbo-charged EVS series is offered in 4, 6 and 8 cylinder sizes, rated 240, 360 and 480 hp at the same speed. All models have 8¾x11½-in. bore and stroke. Engines have high degree of reliability in sustained heavy-duty operation, are simple in design and have more safety devices than offered by equivalent power units. All units are totally enclosed but have large, nonresonant access doors on both sides of the frame. Typical applications on constant or varying loads are industrial and municipal lighting and power service, radio stations, lighthouses, airports, hospitals, department stores, apartment houses, pumping stations, and many others.
**Lister-Blackstone, Inc, 420 Lexington Ave, New York 17, N. Y.**

*For more data on these items, use post cards, p171. Identify request with P and number.*



### VAPOR PURIFIER P1122

Unit protects turbines and steam engines by removing damaging slugs of entrainment. Also, in exhaust steam installations where oil and other undesirables must be removed, and for removing condensate from compressed-air systems.

Company guarantees units to render satisfactory service at all times, and makes specific guarantees for individual applications. In steam installations unit is guaranteed to deliver 99.9% quality steam, That is, it purifies steam from boiler having concentration of 1000 ppm solids to less than 0.5 ppm solids. In exhaust steam, it is guaranteed to remove 99% of oil or to deliver exhaust steam containing less than 2.5 ppm oil.
**V D Anderson Co, 1935 W 96 St, Cleveland 2, Ohio**

### FIBROUS SILICA INSULATION P1103

*Refrasil* fibrous silica insulation comes in bulk fiber, batt, cloth, cordage, sleeving and tape forms. It has good chemical resistance and is particularly suited for high-temperature applications. A few uses are for electric space separators (thermocouple wire insulation), high-temperature thermal insulation, filtration of corrosive or high-temperature materials, and plastic laminates.
**The H I Thompson Co, 1733 Cordova St, Los Angeles 7, Calif.**

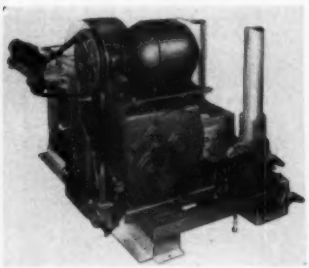
### MULTIPURPOSE LUBE P1120

Hood *Multiplex* lubricant produced in grades from No. 00 to No. 3. Retains lubricity and adhesive characteristics under all normal temperature conditions.

Insoluble in water, but absorbs moisture in service without losing adhesive or lubricating qualities. Recommended wherever water or moisture is problem.
**Hood Refining Co, Greensburg, Pa.**

***Now Take Another Minute To Check These . . .***


**Pumps** for general purpose ..... p 176
**Bench-Type** parts cleaner ..... p 178
**Tester** spots armature troubles ..... p 178
**Scanner** safeguards combustion ..... p 182
**Trolley Hoist** to 3 ton capacity ..... p 184
**Vertical** capacitor motor ..... p 186

### STOKER-DRIVE P1107

Accurate coal-feeding rate results from use of infinitely variable transmission on two *Coal Flow* stokers. Unit mounts above conveyor worm for greatest care in servicing and for safety in flood periods. Mechanism is said to be simple, durable. Has automatic overload device and torque indicator of spring-scale accuracy.
**Iron Fireman Mfg Co, 3170 W 106th St, Cleveland, Ohio**

### SAFETY SPOUT P1111

Safety air-vent pouring-spout fits any size carboy. Gives smooth, even flow without spurts or splashes. It is made of special, acid-resistant rubber and plastic tubing with capacity of 5 gal per min.
**General Scientific Equipment Co, 27th & Huntingdon St, Philadelphia 32, Pa.**

### VOLTAGE TESTER P1118

Redesigned tester with insulated one-piece molded case. Slotted receptacle on each side provides test mount for either

(*Continued on page* 176)

WELDOLETS

WELDING FITTINGS FOR ANY PIPING SERVICE

NATURAL GAS COMPRESSOR STATION PIPING CONSTRUCTED ECONOMICALLY AND EFFICIENTLY USING WELDOLET WELDING FITTINGS THROUGHOUT

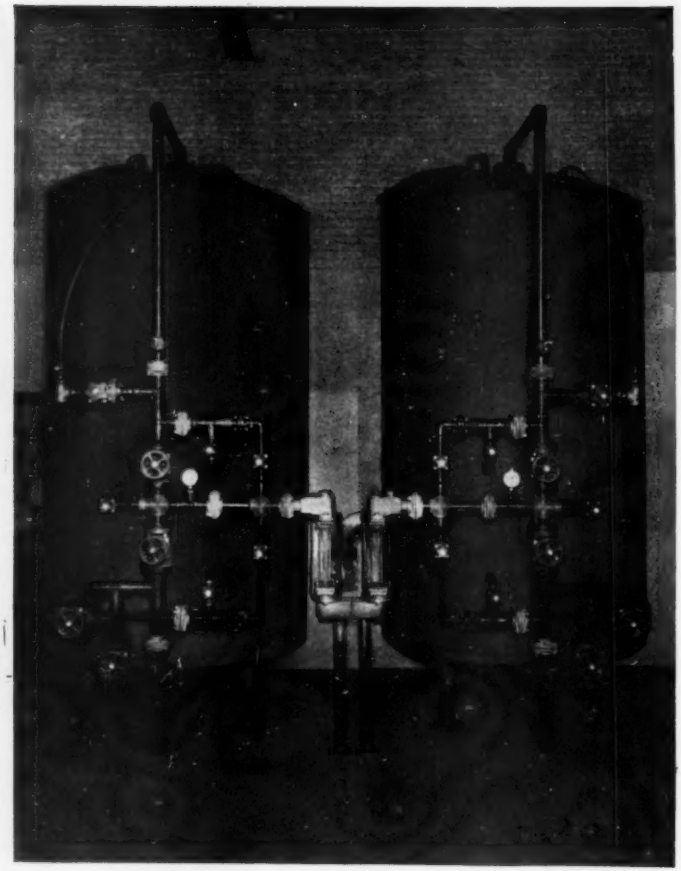
This installation, together with a number of important applications of WeldOlet Welding Fittings in various types of service is shown in the new Bonney W-3 WeldOlet Catalog.

The completely new Bonney catalog will furnish descriptions, dimensional information and installation instructions. The technical section demonstrates graphically how WeldOlet Welding Fittings offer the quickest, safest and most economical method of establishing and maintaining 100% pipe strength at branch connections in accordance with code provisions.

*Write for your free copy to:* BONNEY FORGE & TOOL WORKS 208 Green St., Allentown, Pa.

Export Distributor: NATIONAL SUPPLY EXPORT CORP., 600 Fifth Ave., New York 20, N. Y.

# Silica
# < 0.01 ppm



**DUPLEX MIXED-BED** de-ionizing unit for Eastern public utility company, photographed during fabrication in the Illco-Way shop. Unit is designed to produce a water of the highest chemical purity including complete silica and $CO_2$ removal and with a composite resistance of 8,500,000 ohms per $cm^3$.

▶ SINCE THE FIRST Mixed-Bed De-ionizing unit* was introduced to the industry by the Illinois Water Treatment Co. in 1949, this method for purification has rapidly gained acceptance.

At the present time, according to ILLCO-WAY records, more than 2,500,000 pounds per hour, with silica content of less than 0.01 parts per million, are being produced by ILLCO-WAY Mixed-Bed* equipment.

With feedwater containing less than 0.1 parts per million ionizable solids, and with a composite resistance of 8,500,000 phms per $cm^3$, boiler and turbine maintenance is greatly reduced and operating efficiencies are improved.

Purity is constant regardless of load variations. ILLCO-WAY Mixed-Bed units are designed for either manual or automatic operation, and can be operated on raw water supplies or added as a final treatment to present conditioning equipment. Complete literature on de-ionizing can be secured by writing to ILLCO-WAY.

**Process and equipment patents pending.*

**Analysis of Feedwater (Parts per million as $CaCO_3$)**

*(Analysis made by an independent laboratory of a feedwater produced by Illco-Way Duplex Mixed-Bed system)*

| | | |
|---|---|---|
| **Ca - 0** | **$HCO_3$ - 0.05** | **$CO_2$ - 0.04** |
| **Mg - 0** | **$SO_4$ - 0** | **$SiO_2$ - 0.01** |
| **Na - 0.05** | **Cl - 0** | **pH - 6.80** |

**ILLCO-WAY**

**DE-IONIZING**
**DE-ALKALIZING**
**SOFTENING**

*See data in Sweet's File, Engineering*

**ionXchange**

**ILLINOIS WATER TREATMENT CO., 853-9 Cedar St., Rockford, Illinois • 141 East 44th Street, New York City**

*Canadian Distributor: Pumps & Softeners Ltd., London, Ontario*

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**B2** AIR DISTRIBUTION — Pictures air-distribution outlets in television studios. Lists bulletins with data on ceiling outlets for offices, studios, reception rooms, space permitted. No. F-4712. Barber-Colman Co, Rockford, Ill.

**B3** AIR FILTERS—Lists name and size of air-filter units for filter-equipped warm-air furnaces and blowers of 166 mfrs. 56-page booklet. Owens-Corning Fiberglas Corp, Wayne Bldg, Toledo 1, Ohio.

### BOILERS AND AUXILIARIES

**B4** STOKERS—Roto stoker for firing refuse, coal or combination. Spreader-stoker type. Diagrams, installation photos, 32 pages. Detroit Stoker Co, Monroe, Mich.

**B5** STEAM GENERATORS — Power-master units for steam or hot water. High or low pressure. 15 to 150 hp, oil or gas fired. Bulletin 1218. Orr & Sembower, Inc, Morgantown Rd, Reading, Pa.

**B6** ASH AND FLYASH HANDLING SYSTEMS—Question and answer booklet on hydraulic and pneumatic equipment. Also covers disposal schemes. Diagrams, drawings. Beaumont Birch Co, 1255 Race St, Philadelphia 3, Pa.

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**B7** CENTRIFUGAL BLOWERS AND COMPRESSORS—Data on multi-stage, single stage with end-suction, single stage with double-suction units. Capacities 1000 to 150,000 cfm, pressures to 150 psi and above. Photos, compressor charts, formulas, constants. 48 pages. Bulletin 0660. DeLaval Steam Turbine Co, Trenton 2, N. J.

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hp. Cross-section diagrams. 8-page bulletin No. 212. Bury Compressor Co., 1112 Cascade St, Erie, Pa.

**B9** BLOWERS—And chemical processing equipment. Axial-flow, positive-pressure blowers from 745 to 2920 cfm, 700 to 3450 rpm. 12-page bulletin No. 51769. Read Standard Corp., 370 Lexington Ave, New York 17, N. Y.

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**B13** CONTROL VALVES — Pressure master controls, desuperheaters, temperature master controls, water-regulating valves, feedwater heaters, etc. 12-page bulletin No. S-196-C describes complete line power-plant equipment. Flow diagrams, dimensions. Swartwout Co, 19611 Euclid Ave, Cleveland 12, Ohio.

**B14** COMBUSTION CONTROL—Installation at Fulton Sylphon Co. Diagrams, photos showing boiler plant modernization. 8-page bulletin No. E-3. Hays Corp, Michigan City, Ind.

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**B16** MINIATURE ELECTRONIC CONTROL — For pressure, temperature, flow and level in power and process industries. With or without recorder. Photos, diagram, dimensions. 4-page bulletin No. A-701. Swartwout Co, 19611 Euclid Ave, Cleveland 12, Ohio.

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**B17** SQUIRREL - CAGE INDUCTION MOTORS—Up to 1750 hp at 1800 rpm. Special electrical modifications to suit requirements. 6-page bulletin No. 06B7144A shows construction features, available ratings. Allis-Chalmers Mfg Co, 963 S 70th St, Milwaukee, Wis.

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**B19** MOTOR - GENERATOR SETS — Motors, generators, transformers, diesels, air compressors. New and rebuilt. All sizes bought and sold. These 8-page bulletins, No. 81 & 82, C. give starting stock list. Electric Equipment Co, PO Box 51, Rochester, N. Y.

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**B21** MOTIVE POWER STORAGE BATTERIES — Data sheets on servicing "nickel-cad" batteries. Six cases, given attention. 7 pages. Gould National Batteries, Inc, Trenton 7, N. J.

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**B23** BATTERY CHARGER—For lead and Edison batteries. Needs little attention during charge. 4-circuit magnetic generator - operated integral - control panel. 4-page bulletin No. 3-11-120. Photos, dimensions. Electric Products Co, 1735 Clarkstone Rd, Cleveland 35, Ohio.

**B24** INDUSTRIAL ELECTRONIC EQUIPMENT — Electronic tubes, test instruments, voltage stabilizers, transformers, tools, batteries, sockets. Complete catalog information. 212 pages. Allied Radio Corp, 833 W Jackson Blvd, Chicago, Ill.

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**B25** INSTANTANEOUS WATER HEATERS—Heat up to 300 gpm with live or exhaust steam. No storage tank. Water flows through copper tubing, steam supplied to shell. 12-page catalog No. 60. Dimensions, capacities, steam requirements. Also other industrial fluid heating units. General Fitters Co, Dept 37, 118 Georgia Ave, Providence 3, R. I.

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## MATERIALS HANDLING AND MECHANICAL TRANSMISSION

**B28** MAGNETIC SEPARATORS—Pulley, perma-plate, suspended, drum, rectangular, lifting types. All sizes and applications. 12-page condensed catalog No. C-5006-B. Photos; lists catalogs with details. Dings Magnetic Separator Co, 4740 W Electric Ave, Milwaukee 46, Wis.

**B29** RADIAL AND UNIVERSAL DRIVESHAFTS — Spline-jointed and one-piece. Specifications, table of maximum recommended lengths and speeds. Bulletin F-41-51. Morse Chain Co, 7601 Central Ave, Detroit 9, Mich.

**B30** WIRE ROPE — Reprint article. Examples of misuses and damage of wire rope, methods of proper use, maintenance, handling and lubrication. 4 pages. Repository—Wire Rope—So What? No. 5154. MacWhyte Co, Kenosha, Wis.

(Continued on page 204)

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# Break Down Your Chinese Wall

EVER SEE THE GREAT Chinese Wall? One astronomer said it's the only man-made structure on earth that might be visible from the moon. This wall is about 1500 miles long. It's 25 ft high, 15 to 30 ft at the base, and has a road on top. There's a guardhouse every few miles.

The Ch'in dynasty started it in 246 BC. The Ming dynasty finished it in about 1500 AD. Why was it built? The Chinese thought it was one way to keep their advanced civilization to themselves—and the barbarians out. But what really did happen? Well, the rest of the world passed up the walled-in Chinese, while the Chinese became a decadent nation and stewed in their own juice—and they are still stewing.

And that brings me to the happiest job I ever had in a power plant. The chief engineer had a habit of calling us in whenever he planned some improvement.

"Here's the picture, boys," he'd start. Then he'd go into details and wind up by letting each of us throw in our oar. And quite often even a green fireman would come up with a good idea. The point is, the chief didn't build a Chinese wall around himself. We were all part of the team. That gave us a sense of security and importance.

But since then I've worked with bosses who have built a thicker wall around themselves than the Chinese ever did. In that setup, because no one but the boss knows what's cooking, the least molehill is quickly built into a mountain. Soon everyone says, "Why the hell should I worry about that? I'm not SUPPOSED to know anything—I only WORK here, let the BOSS worry."

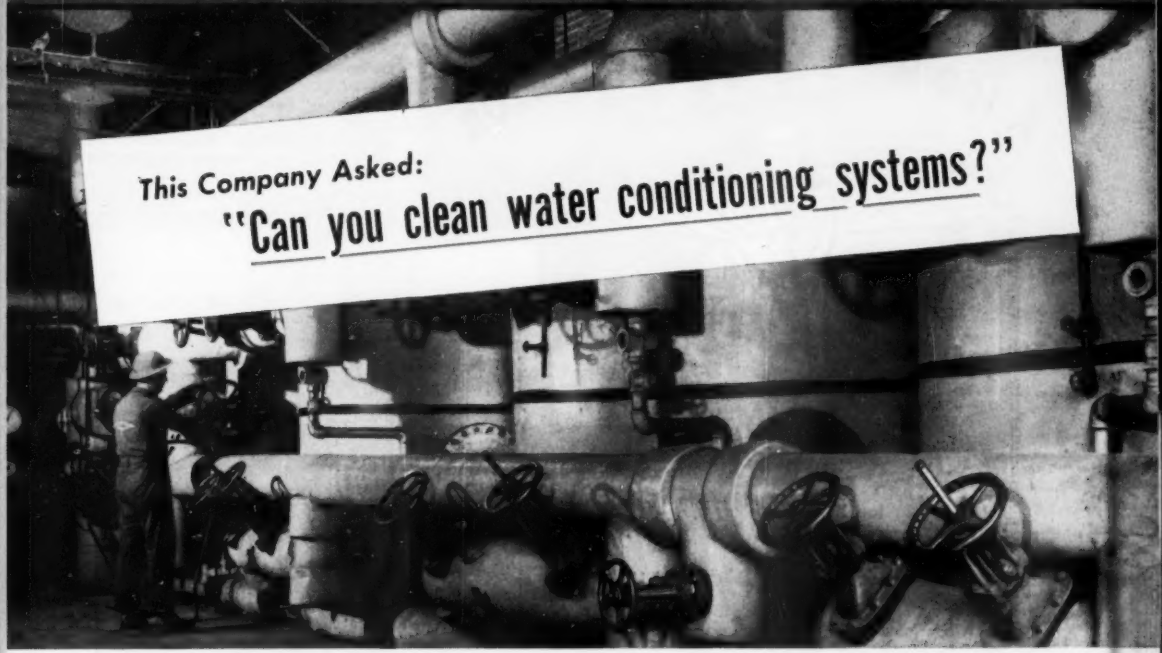
That kind of management doesn't help in our all-out production for security. If you have built a Chinese wall around yourself, start breaking it down today. Look where it got the Chinese.

George Edwards

*Engineer*

# DOWELL SERVICE

*CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS*




## Dowell Service has cleaned many types of water supply equipment FAST!

If deposits are cutting production and profits in your plant . . . Dowell Service offers an effective remedy! For example, in water supply and water treating systems, deposits may accumulate in pipes, pumps and filters . . . impairing operating efficiency. Maintenance men in many industries rely on Dowell Service to clean operating equipment . . . *without dismantling and with a minimum of downtime!*

Experienced Dowell engineers do the job, using Dowell-designed, truck-mounted equipment. Liquid solvents designed to remove deposits quickly, efficiently and economically are applied according to the techniques demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. Often equipment can be cleaned in operation.

Let Dowell Service *save you time and money* in your maintenance cleaning! Call the nearest Dowell office today for FREE consultation.

***Recent Dowell jobs in Feedwater Systems***

**SCREEN FILTERS:** In less than three hours, Dowell Service removed 90% of deposits from filters used to screen river water for a 48" strip mill.

**WATER SOFTENER:** Approximately 18 inches of hard calcium carbonate piled up in the bottom of a water softener's deareating compartment. In less than one day, Dowell Service thoroughly cleaned compartment.

**FILTER BEDS:** The backwash rate on an anthracite filter was reduced to 75 gallons per minute by accumulated deposits. After Dowell Service, backwash rate was increased to an effective 385 gallons per minute.

**ION EXCHANGE BEDS:** Iron oxide clogged an ion exchange water softener. Before cleaning, two pumps were required to provide pressure for adequate back wash. After Dowell Service, one pump was sufficient.

**FEEDWATER LINES:** Before cleaning, it was necessary to use three 100 horsepower pumps to force water through clogged feedlines to a boiler house. Following Dowell Service, only one pump was required.

**PUMP:** Two high pressure feedwater pumps were nearly clogged with deposits. Dowell service completely cleaned them along with rest of the feedwater system.

**WATER WELL:** Before treatment, a water well produced only 108 gallons per minute with a 35' drawdown. After Dowell acidizing, water flow increased to 450 gallons per minute with a 27' drawdown.

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# MORE STEAM in LESS SPACE... at LESS COST!

The Clayton Forced Recirculation Steam Generator produces more steam per pound of weight and per cubic foot of space occupied than any boiler known... and at less cost. Fast steaming, automatic and safe, the Clayton Generator sets a new standard of efficiency for the production of processing steam. It is the only steam generator with a cost curve that parallels the load demand curve through all stages of operation. Each unit... 15 to 100 h. p.... is complete, ready to connect and operate upon delivery. No burners, pumps, instruments or accessories to buy.

**THIS COUPON BRINGS PROOF TO YOUR DESK**

An animated, colored flow chart shows you how and why the Clayton Forced Recirculation principle can cut your steam costs.

P-11

CLAYTON MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.

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Clayton

MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA


## More EQUIPMENT NEWS

Begins on page 162

prod. When not in use prods may be inserted in bottom of receptacle, completely shielding sharp points. Tester can then be conveniently and safely carried in pocket or case.

Operating parts interchangeable with previous *Wigginton* testers, making service parts readily available. Range covers 110, 220, 440, 550 volts ac, and 125, 250, 600 volts dc. Also available for 400-cycle systems. For descriptive literature address: **Square D Co, 6060 Rivard St, Detroit 11, Mich.**

For more data on these items, use post cards, p171. Identify request with P cnd number.

### WATER SOFTENER P1128

Heavy-duty water softener ideal for medium-sized industrial applications has been added to the company's line. The new *Supreme* 600,000-gr capacity model has the exclusive patented automatic backwash control to give complete zeolite cleaning at low water pressures and yet guarantee against loss of mineral at high city pressure. Unit has no moving parts. Twin sizes up to 1,200,000-gr capacity can also be had. **Bruner Corp, Milwaukee 45, Wis.**

### TEMPERATURE CONTROL P1112

Sensitive, modulating, pneumatic temperature-control. Model HA has pilot air valve that can handle up to 15-psi air pressure. Operates any diaphragm valve or motor. Base and lever are rigid castings, and heavy spring moves lever to operate stem of pilot air valve.
**Burling Instrument Co, 5 Vose Ave, South Orange, N. J.**

### GENERAL-PURPOSE PUMPS P1104

Type SCC pumps are close-coupled units with mechanical seals. They are suited for any small-pump application like small cooling towers and hot-water heating systems. Standard pumps are bronze fitted with casing and motor stand of close-grained high-quality cost iron. Impellers and wearing rings are hard bronze. Pumps can be supplied in other materials or alloys on special order. Two sizes are: 2-in. suction, 1¼-in.

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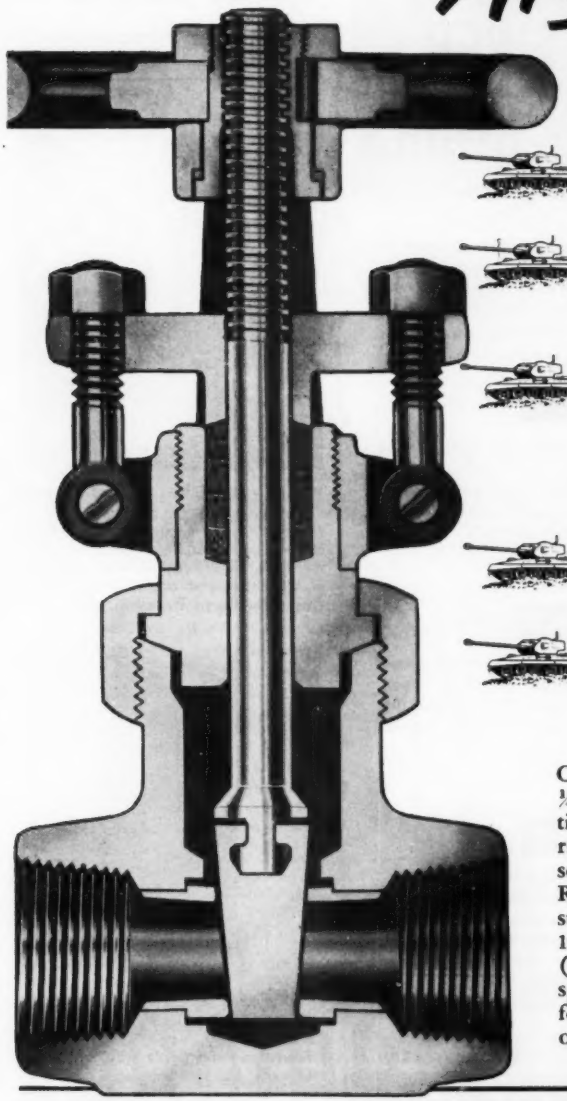


**Body and Yoke are of Forged Steel,** for extra strength and longer life.

**Bolted Follower**
with no follower threads on yoke to corrode. Follower easily tightened down any time when necessary.

**Malcomized Gate Faces:**
When furnished with either 12-14% or 18-8% stainless steel trim, List 960's gates are hardened by "Malcomizing," patented Chapman process. "Malcomizing" hardens to a minimum of 800 Brinnell, which minimizes seizing or galling and lengthens valve life.

**Super-Hardened Seat Rings**
and wedge-faces of stainless steel help to save on repairs and replacements.

**Strong Stem and Wedge Connection**
Extra strength of stem-and-wedge gate connection provides protection against even unusual service stress.

Chapman List 960 is available in sizes from ¼" to 2" . . . in four different alloy-combinations of body and trim which qualify this rugged forged gate valve for many different services. Gasketed joint, or metal-to-metal. Rising stem with yoke (shown) or rising stem inside screw. Pressure range: 2000 lb. at 100°F.—380 lb. at 1000°F. (for higher pressures, specify List 990). Write for illustrated fact-sheet on List 960.

## CHAPMAN'S LIST 960 FORGED Gate Valve

**The Chapman Valve Manufacturing Company**
INDIAN ORCHARD, MASSACHUSETTS

NOW, AS ALWAYS

PABCO PRECISION MOLDED 85% MAGNESIA HEAT INSULATION

FEWER MAN-HOURS

MODERN ENGINEERING demands precise standards of heat insulation performance. Pabco's *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

PABCO PRECISION MOLDED INSULATIONS

APPROVED ENGINEERING SERVICE UNIT

EASIER TO CUT

Pabco *Precision Molded* 85% Magnesia cuts easily and cleanly. That's because Pabco's manufacturing methods give you "ductile" strength and firmness unprecedented in the field of heat insulation materials.

BLOCKS SCORE CLEANLY

Pabco *Precision Molded* 85% Magnesia Blocks score quickly and cleanly. So important when splitting, or when preparing "hinges" for application to large rounded surfaces.

SMOOTH RIND SURFACE

Because Pabco *Precision Molded* 85% Magnesia is molded to exact final size and thickness, its surfaces are smoother with a finished "rind." Easy embedding of tie wires, a stronger surface . . . and a faster, easier clean-up!

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

PABCO PRODUCTS INC.

INSULATION DIVISION

San Francisco 19 New York 16

Manufacturers of Heat Insulation Since 1920

PABCO ENGINEERING SERVICE UNITS IN ALL PRINCIPAL CITIES

# More EQUIPMENT NEWS

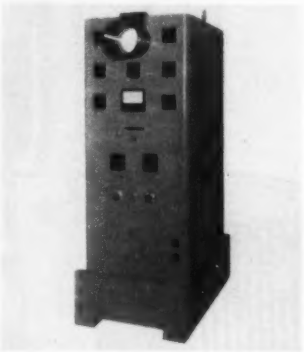
Begins on page 162

discharge; 1½-in. suction with ¾-in. discharge. Both operate at 3450 rpm. Capacities range to 100 gpm at heads to 120 ft. **Economy Pumps, Inc, Div of Hamilton-Thomas Corp, Hamilton, Ohio**

For more data on these items, use post cards, p171. Identify request with P and number.

**PARTS CLEANER** **P1109**

Low-cost bench-type parts cleaner, *Brush Flush*, has handy fountain action. Features hollow-handle brush attached to pump through a tube. Pump delivers steady flow of clear solvent at end of brush bristles. **Graymills Corp, Evanston, Ill.**



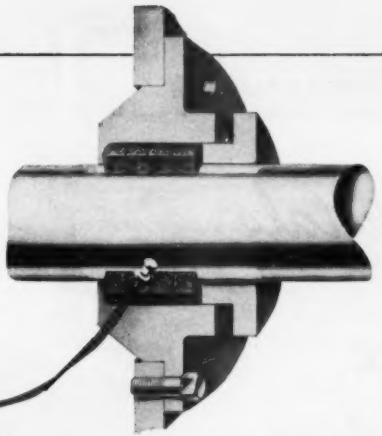
**ARMATURE WINDING TESTER** **P1117**

Insulation tester for dc armatures, series field coils, and low-impedance ac stator coils. Detects and aids in locating faults in turn-to-turn, coil-to-coil, and winding-to-ground insulation in dc armatures of any size and rating. Designed for testing large motors and generators like those in railroad, marine and steel industries.

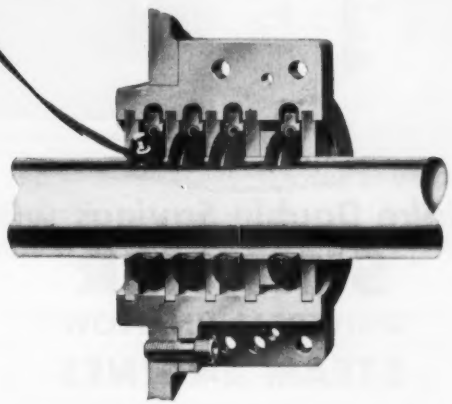
Unit consists of repeating-type surge-voltage generator operating 60 times a second and cathode-ray oscilloscope, both in one

# COPPUS TURBINES

*offer you a choice of packing rings*



**STANDARD METALLIC RING PACKING** — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.



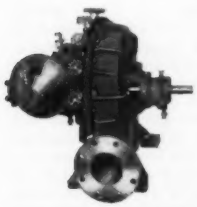
**OPTIONAL CARBON RING PACKING** — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

***Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.***

***Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes***

## FIT TURBINE COSTS TO HORSEPOWER NEEDS

When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .



**WRITE FOR BULLETIN 135**

COPPUS ENGINEERING CORPORATION
171 Park Avenue
Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

# COPPUS "BLUE RIBBON" TURBINES

Three-cylinder "Universal Unaflow" with 600-kw. D-C generator, in hospital.

## Make Double Savings with

# SKINNER

## "UNIVERSAL UNAFLOW"

## STEAM ENGINES

Hotels, hospitals, and office buildings from coast to coast are saving thousands of dollars every month through the economies made possible with Skinner "Universal Unaflow" Steam Engines.

They have their own source of power . . . dependable, unfailing, economical . . . to drive generators for lighting, for operating elevators and other mechanical equipment . . . to drive compressors . . . for refrigeration and air conditioning. They have exhaust steam . . . a by-product for space heating and laundry.

These double economies have earned millions of dollars for Skinner Engine owners over a period of more than four decades. Many of the installations were made on the basis of acceptance tests, with penalty for failure to prove guaranteed economies . . . *and no SKINNER engine has ever failed to make good.*

*Write for case studies of what has been accomplished in conditions similar to yours.*

*For Over 80 Years, Doing One Thing Well—Building Steam Engines*

**SKINNER ENGINE COMPANY, ERIE, PA.**


# More EQUIPMENT NEWS

Begins on page 162

cabinet. Tester can check entire armature in three or four minutes. As each is being inspected, oscilloscope screen shows if surge wave is of proper shape and amplitude.

Device is 20 in. wide, 30 deep, 48 high, and weighs about 800 lb. Operates on a power supply of 230 volts, 60 cycles.

**General Electric Co, Schenectady 5, N. Y.**

For more data on these items, use post cards, p171. Identify request with P and number.

### CENTRIFUGAL FAN P1102

Centrifugal-fan arrangement features weatherproof hood over motor-drive section. When protected by hood, fan may be installed outdoors without further enclosure. Available with wheel dia as large as 60 in., backwardly inclined and forwardly curved blades, single-width single-inlet models in Class I construction. High efficiency, low noise and low horsepower.

**The Trane Co, La Crosse, Wis.**

### BRAZING STRIP P1129

A low-carbon steel strip called *Braze Clad* has a silver brazing alloy on one or both sides in any thickness ratio and melting range to suit the requirements of each particular brazing application.

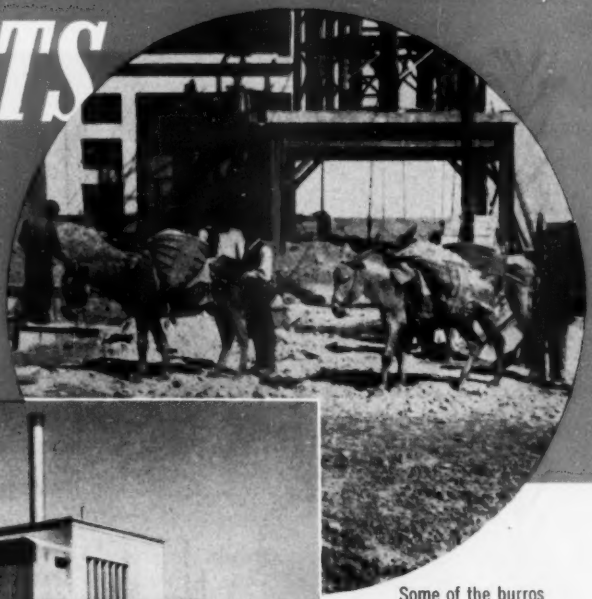
The steel surface precoated evenly with the brazing alloy makes no preplacements necessary and every joint is assured of a complete and uniform spread of alloy. In conventional brazing where preplacements of silver alloy strips are used, voids leading to joint failures are known to occur. *Braze Clad* will prove most useful wherever brazed joints must be perfect, where they must stand a severe pressure test, or where preplacements are difficult and slow.

**American Silver Co, Inc, 36-07 Prince St, Flushing, N. Y.**

### WELDING ROD P1130

New bronze welding rod, *EutecRod* 148 SC, features an extra thin initial tinning action, which is said to be capable of eliminating prewelding preparations re-

# CONTRASTS in Spain



Some of the burros on the plant site.

New power plant at Puertollano, Spain, operated by Empresa Nacional Calvo Sotelo de Combustibles Liquidos y Lubricantes.

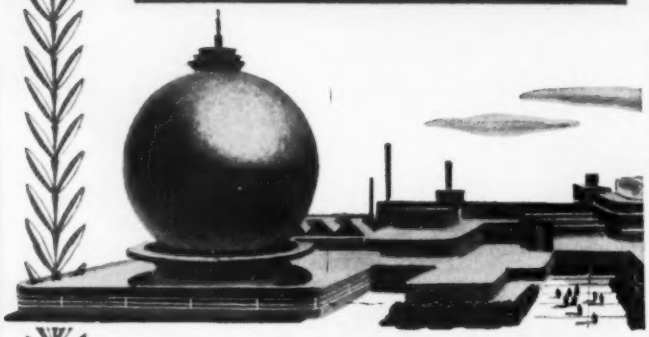
**The most ancient** and the most modern methods of material handling are both represented at this new generating plant at Puertollano, Spain. During the excavation phase, part of the "trucking" fell to the lot of slow, plodding burros. At the other end of the efficiency scale are the Hydrojet and Hydrovac Systems that will dispose of the ashes and dust when the plant goes into operation.

Built to supply both electrical power and process steam for the combination oil refinery and shale oil plant nearby, the installation will have five Foster Wheeler boilers when completed. Each will deliver 150,000 lb-per-hr of steam, having a superheater outlet pressure of 630 psi and a temperature of 830°F. Water used in the Hydrojet and Hydrovac Systems will be recirculated, while the ashes and dust will be removed in railroad cars.

**THE ALLEN-SHERMAN-HOFF CO.**
**Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.**
*Offices and Representatives in Principal Cities*

**HYDROJET** (hydraulic) **HYDROVAC** (pneumatic)
**materials handling systems**

. . . The Trend in Progressive Thinking



Top management is coming more and more to seek the services of independent consulting engineering organizations to supply specialized talent in working out modernization programs, new plant designs, expansions, and related projects.

The modern consulting engineering organization consists of a completely coordinated staff of architectural, civil, chemical, electrical, and mechanical engineers with broad experience in their respective fields.

For over a quarter of a century the Peter F. Loftus Corporation has had the privilege of cooperating with the management and engineers of many utilities, industrials, institutions, and governmental agencies.

Peter F. Loftus Corporation
Established 1923

ENGINEERING CONSULTANTS
*First National Bank Building, Pittsburgh, Penna.*


## More EQUIPMENT NEWS

Begins on page 162

quired by conventional rods. Each rod is covered with a new type of specially developed flux coating, yielding full-strength joints on old, corroded and dirty cast iron. Its tensile strength is listed at up to 55,000 psi with a Brinell hardness of 75 to 120.
**Eutectic Welding Alloys Corp, 40-40—172nd St, Flushing, N. Y.**

For more data on these items, use post cards, p171. Identify request with P and number.

**SIGNAL TRANSMITTER P1131**

High-pressure flow signal transmitter, pneumatically-operated flow-differential measuring unit, carries signals to remote recording or indicating instruments or to automatic-control units. It has interchangeable measuring elements that cover a continuous range of pressure differential from 5.5 in. wg, to 100 psi at static pressures up to 1500 psig. The new instrument can measure flow differentials of liquids, gases, vapors, or static pressure or liquid level. Accuracy is within 1% of full-scale reading. A change of only 0.1% in applied pressure differential affects a change in loading pressure when sending maximum loading pressure.
**Hagan Corp, Hagan Bldg, Pittsburgh 22, Pa.**

**COMBUSTION-SAFEGUARD SCANNER P1132**

Combustion-control system provides complete flame-failure protection for gas, oil, or pulverized-coal-fired furnaces. The new scanner sees all types of flames and gives quick and positive response to flame failure to protect against danger of explosions. Very compact, the scanner is installed in end of a standard ½-in. pipe nipple where it can see the flame area. It replaces both flame rod and photoelectric tubes.

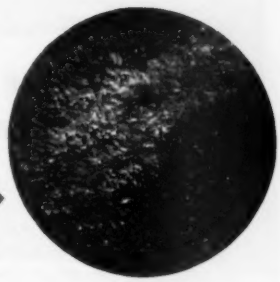
Once installed, scanner requires no service other than keeping its lens clear so it can see. It discriminates between glowing refractories and live flame and will not respond to sunlight, artificial light, or other sources of radiation.

The scanner is used with programming

# Will Corrosion, Carryover or Tube Failure Tie-Up Your Boilers This Month?

Whether you operate high or low pressure boilers . . . corrosion, carryover and tube failures are mighty expensive . . . not only in tube replacement and installation costs, but in loss of valuable production time.

These photomicrographs show how proper treatment can reduce tube failures.



On this tube from a high pressure boiler, iron oxide particles have deposited as magnetic iron oxide "scale." Even when distilled make-up is used, this type of deposit frequently occurs, causing tube failure. Although the conventional alkali-phosphate-organic treatment was used, it did not prevent deposits from adhering.

This is a tube operating under similar conditions except that the boiler water has been treated with Drew Complete Boiler Water Treatment. This treatment chemically alters iron oxides—and other types of deposit formations. It makes them non-adherent and eliminates costly tube failure.

*Send for new* DREW ORGANICS *folder describing the use of organics in modern boiler water treatment. Write today.*

Whether you operate high or low pressure boilers . . . whether your tube failures are caused by iron oxides or any other type of deposit . . . you'll find that Drew can provide a practical, economical solution to your water conditioning problems. Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies.

POWER DREW CHEMICALS

*Power Chemicals Division*

**E. F. DREW & CO., INC.**

**15 East 26th Street, New York 10, N. Y.**

DREW PRODUCTS

*Nationwide Service in Boiler Water and Cooling Water Conditioning*

# UNDERCOVER ANSWER TO A HOT PROBLEM

Oven-fresh coke may be well over 350° hot when hauled away from the quenching area by a rubber covered conveyor belt. That is why ordinary belts lead such a short, scorched life when used for handling coke, or sand, or lime, or sinter (roasted ore) as well as other materials that are hot.

To solve such problems, Hewitt-Robins developed belting built up inside with plies of Fiberglas*, cotton, asbestos and synthetic fabrics—and covered outside with especially developed and compounded rubber and synthetics. The fabrics contribute to high dimensional stability and tensile strength; the covers resist heat and abrasion. Both combine to give Hewitt-Robins Hot Materials Conveyor Belting much longer service life.

Hot Materials Conveyor Belting is one of many Hewitt-Robins "firsts" in materials handling belting, machinery and techniques. It is a product of an organization unique in its field. Only Hewitt-Robins can deliver—from within its own corporate structure—all three elements of a belt conveyor system: engineering, machinery *and belt*. Only Hewitt-Robins can assure individual responsibility for their successful operation—because only Hewitt-Robins makes them all.

*When the handling of materials—hot or cold—is your problem, we invite you to make it ours. Our three industrial divisions are ready, individually or collectively, to meet your needs.*

*T. M. of Owens-Corning Fiberglas Corp.

HEWITT HR ROBINS

*Executive Offices:* 370 Lexington Avenue, New York 17, N. Y.

**HEWITT RUBBER DIVISION:** Belting, hose and other industrial rubber products

**ROBINS CONVEYORS DIVISION:** Conveying, screening, sizing, processing and dewatering machinery

**ROBINS ENGINEERS DIVISION:** Designing and engineering of materials handling systems

Hewitt-Robins is participating in the management and financing of Kentucky Synthetic Rubber Corporation

# More EQUIPMENT NEWS

Begins on page 162

control to provide complete starting and operating protection for full automatic gas, oil, or pulverized-coal burners or dual-fuel burners. Fuel-safe circuits cause immediate shutdown in equipment failure. Faulty components or circuits shut off the fuel, making it impossible to operate without flame-failure protection. Bulletin No. CP511. **Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.**

For more data on these items, use post cards, p171. Identify request with P and numb.r.

## TROLLEY HOIST P1133

Built in capacities from ½ to 3 tons, these hoists are available with a special load bar, and either a pair of 2-wheel plain trolleys, or one plain and one geared 2-wheel trolley. The plain trolley assembly has chilled tread wheels with ball bearings, steel side plates and connection to load bar.

Geared trolley is the same as the plain except that the wheels have gears with cut teeth, pinions with cut teeth, hand chain and chain guide. Thrust roller holds proper alignment of the assembly on straight or curved track. For service where close headroom is required. Leaflet DH-269 available.

**Wright Hoist Div, American Chain & Cable Co, York, Pa.**

## LAMP ANNUNCIATORS P1134

Heavy-duty-type ANN18, using lamp units with 2-in. beehive lenses and engraved lamicoid designation strips. Relays are the modern "plug-in" type, mounted directly to the rear of the lamp units. Suitable for all voltages up to 250, ac or dc with type S6 and T2 bulbs.

Automatic service provides an audible as well as visual signal. Cutting off audible signal for one section does not prevent

# LUNKENHEIMER
## *Shoulder-Less Steel Valve Seat Rings . . .*

- CAN'T WEDGE OUT OF PLACE
- SEAT TIGHTER WITH SERVICE
- ASSURE GREATER BODY STRENGTH
- WILL NOT WARP
- EASILY RENEWABLE

Notice how the inner facing of the Lunkenheimer ring seats squarely against the body wall. There's no flange or shoulder where corrosion can work its way inside — no bending that causes leakage.

This end-seated Lunkenheimer ring *stays put* — won't warp out of place or twist away from the body as it is tightened. See how firmly the heavy ring seals itself into the wall, becoming an integral part of it, adding *extra* strength at the "nerve center," guarding against corrosion.

*And this ring actually seats more tightly with years of wear.*

Should you ever need to replace it — heavy lugs inside the ring make renewal simply a matter of screwing the old one out, the new one in . . . quickly, without serious production delays.

Before you approve that next order for steel valves in your plant, be sure to double-check seat ring construction. For longer life and lower maintenance costs, specify Lunkenheimer steel valves . . . with *shoulder-less* seat rings.

*Write today for your copy of "Lunkenheimer Cast Steels,"* an informative 52-page brochure on the development and application of steel valve alloys. *The Lunkenheimer Co., Box 360-A, Cincinnati 14, Ohio.*

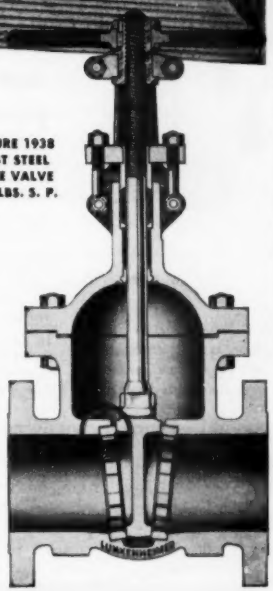
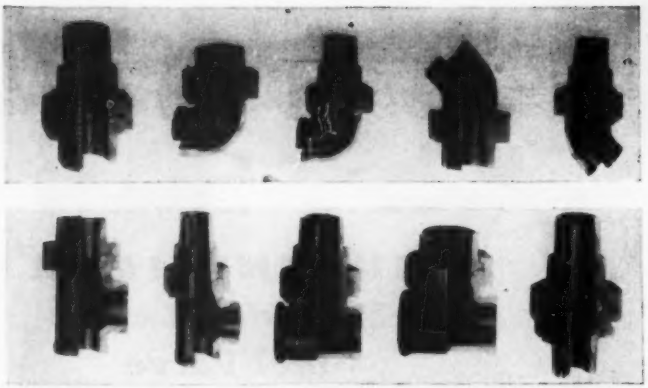


FIGURE 1938
CAST STEEL
GATE VALVE
300 LBS. S. P.

STEEL • IRON • BRONZE

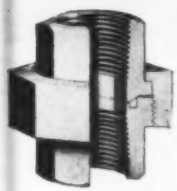
# LUNKENHEIMER
THE ONE *Great* NAME IN VALVES

L-451-5



Jefferson

AIR-REFINED, AIR-TESTED
MALLEABLE IRON
UNIONS
... featuring the RECESSED BRASS SEAT



**You get better performance when you use "JEFFERSONS"**

The permanent leak-proofness of Jefferson Unions means less attention and definite savings in maintenance. Furthermore, the completeness of the Jefferson line in types and sizes is assurance that you can meet all your needs.

The exclusive Recessed Brass Seat offered in Jefferson Unions provides self-seating, and free flow through the fitting. The seat, consisting of a ring of seamless brass tubing is force-fitted into a machined recess for permanent tightness. This seat is spherically finished to mate with the similarly finished iron of the fitting to provide a true brass and iron ball joint.

In addition to its regular line, Jefferson offers AAR 300#, Enduro 300#, Excel 250# and Master 150# Unions. Unions with all-iron ground seats are also available.

*Your nearest distributor will supply your needs— or contact us direct.*

Jefferson UNION CO.

605 W. 26th St. New York 1, N. Y.
61 Gooding St. Lockport, N. Y.
39 Fletcher Ave. Lexington 73, Mass.

# More EQUIPMENT NEWS

Begins on page 162

receiving the audible signal from any other sections that may become abnormal. Lamp annunciators supervise any and all things that can be equipped with electrical contacts, such as: pressure, temperature, vaults, switches, liquids, etc.
**The H R Kirkland Co, Morristown, N. J.**

For more data on these items, use post cards, p171. Identify request with P and number.

**MECHANICAL SEAL** **P1135**

The high heat resistance and extremely low friction and chemical inertness of *Teflon* is used by the manufacturer in developing the Type 9 mechanical shaft seal. This seal, designed for rotating shafts such as centrifugal pumps, turbines, agitators, was constructed in the end-face sealing principle. It can be employed at temperatures in the steam, water, etc that do not exceed 500 F.

The setscrew metal retainer provides a positive drive from shaft to carbon sealing washer through dents that fit into washer notches. An effective seal between shaft and washer is insured by a precision-machined *Teflon* wedge ring preloaded by the action of multiple spring. Spring pressure is distributed evenly by a metal disk. A lapped raised face on the rotating sealing washer mates against the highly lapped face of the stationary seat to give a heatproof seal with little running friction.
**Crane Packing Co, Dept 3.22, 1800 Cuyler Ave, Chicago 13, Ill.**

**VERTICAL MOTORS** **P1136**

Solid-shaft, vertical capacitor motors feature in ratings from ¾ to 5 hp, and are an addition to the company's *Tri-Clad* integral-horsepower, single-phase motor line. These capacitor motors with squirrel-cage rotors have no brushes or commutators. They provide quiet operation without causing radio interference.
**General Electric Co, 1 River Rd, Schenectady 5, N. Y.**

**TABLET DISPENSER** **P1137**

Sanitary, 95% glass and plastic, strong, foolproof salt-tablet dispenser provides 750, 10-grain salt tablets in easy-to-get-at form, which help the worker reduce heat fatigue from loss of body salt.
**General Scientific Equipment Co, 2700 W Huntington St, Philadelphia 32, Pa.**

**OIL PREHEATER** **P1138**

Fully insulated built-in automatic temperature-control oil preheater uses electric circulation heaters for preheating bunker-C oils to about 170 F. The same packaged electric heater can be quickly connected for economic heating of large quantities of water. For this service, the same style heaters have different ratings—50, 75 and 100 kw. Heavy-steel-pipe housings enclose *Chromalox* heating elements. These ele-

# DEAERATED COOLING WATER SAVES ONE COMPANY

## $85,500 a year!

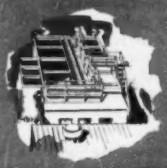
### THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS

**1. SLUDGE BLANKET HOT LIME SODA.** Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

**2. HOT ZEOLITE—PERMUTIT Q.** Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

**3. SILICA REMOVAL PLUS DEMINERALIZATION.** Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

**4. DEAERATING HEATER.** The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free $CO_2$. Capacities from 12,000 to 1,400,000 pounds per hour are in service.



**5. PRECIPITATOR.** The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

### REDUCES CORROSION RATE 90%
### PREVENTS TUBERCULATION
### CUTS TUBE REPLACEMENTS
### LOWERS WATER CONSUMPTION

A chemical company in California installed a Permutit 5,000 gpm Vacuum Deaerator just over 2 years ago. Now here's what they have to say abou it after exhaustive checking and comparison.

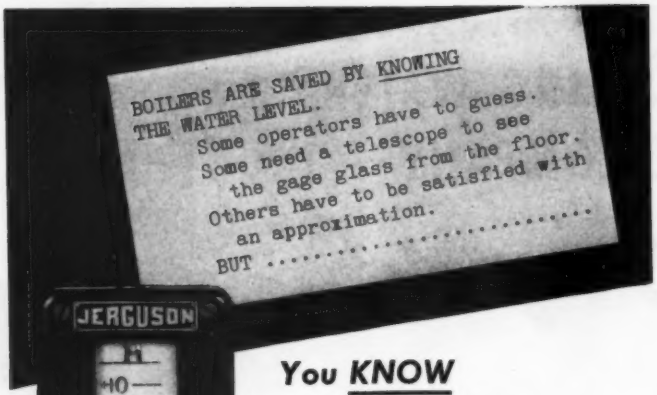
"The benefits occurring from water deaeration are difficult to calculate in their entirety, since so many of the advantages in small items such as clean water lines, better operation of valves, less frequent water line replacement and better water flow cannot be easily assessed. However, the major corrosion costs in this plant . . . have been determined and compared with the cost of deaeration . . ."

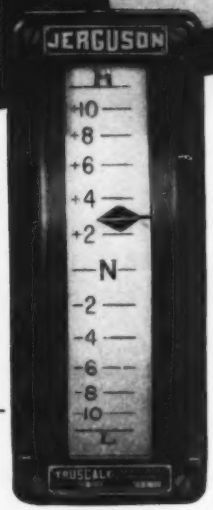
And the report goes on to cite actual net savings of $85,500 per year resulting from the installation of a Permutit Vacuum Deaerator.

Find out how Permutit can solve *your* water problems. Write to the Permutit Company, Dept. P-11, 330 West 42nd Street, New York 18, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

**PERMUTIT®**

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS


BOILERS ARE SAVED BY KNOWING
THE WATER LEVEL.
Some operators have to guess.
Some need a telescope to see
the gage glass from the floor.
Others have to be satisfied with
an approximation.
BUT .....




*Model #2 duplicates water level as shown in gage glass at boiler*

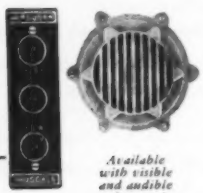
***You KNOW***
***The Water Level***
***When you have a***

# JERGUSON TRUSCALE GAGE

THE Jerguson Truscale Gage for remote reading of boiler and other liquid levels is ACCURATE to ½ of 1% of scale reading.

It is DEPENDABLE, for it works on hydrostatic heads directly from the boiler drum. Simple in design, with magnet external to manometer system, and featherlight pointer system. All internal moving parts of stainless steel; no stuffing boxes.

Models for any pressure and range; illuminated dial; scale markings and pointer glow in the dark.



*Available with visible and audible alarms at auxiliary points*

*Write for full information on Jerguson Truscale Gages*

Marine Operators: *Special installation procedure compensates for roll and pitch of your ship.*

**JERGUSON**

*Gages and Valves for the Observation of Liquids and Levels*

Representatives in Major Cities
Phone Listed Under JERGUSON

**JERGUSON GAGE & VALVE COMPANY**
100 Fellsway • Somerville 45, Mass.
European Mfg. Affiliate: Bailey Meters & Controls, Ltd.


# More EQUIPMENT NEWS

Begins on page 162

ments are alloy sheath for most jobs, but copper sheath for water heating.
**Industrial Heating Div, E L Wiegand Co, 7500 Thomas Blvd, Pittsburgh 8, Pa.**

For more data on these items, use post cards, p171. Identify request with P and number.

**HIGH-PRESSURE GATE VALVE P1139**

Designed for the high-pressure field. Some features of this valve are a bolted bonnet, tongue and groove joint with soft-iron gasket to assure tightness, and hard wedge facing that minimizes seizing, galling and abrasive wear. Stainless-steel gland bolts and nuts prevent freezing or corrosion, while the two-piece gland and follower applies uniform pressure on packing. Sizes run from ¼ to 2 in., inclusive.
**R-P&C Valve Div, American Chain & Cable Co, Inc, Reading, Pa.**

**MERCURY CLEANER P1140**

Large-size mercury oxifier and filter has a capacity of 150 lb and can clean mercury of dissolved base metals up to 600 lb a day in 150-lb batches. When used in combination with Type H filter, it also eliminates floating impurities such as water, oil, dust and acid residue. An electric motor powers a set of paddles, which beat the mercury and whip it into a thick spray for several hours. As the base-metal contaminants come in contact with the air they oxidize to form a powder, which precipitates as a dry noncohesive dust. The dust is then removed by filtering with Type H filter. It weighs 40 lb, stands 31 in. high, and occupies a floor space of 21 in. square. The oxifier stands 21 in. high and requires a floor space of 21x36 in. It weighs 250 lb.
**Bethlehem Apparatus Co, Front & Depot Sts, Hellertown, Pa.**

**SAMPLING OR VENT VALVE P1141**

Double-duty style SFS valve can be used for sampling oils and other liquids or for venting air into tanks. Designed principally for use on oil-immersed electrical equipment like transformers, regulators, etc, the valve has many applications on a variety of industrial equipment and proc-

# WHY handle 3 or 4 lubricating oils for auxiliary plant equipment?

Gulf Harmony Oil is equally effective for sleeve-type bearings, oil-lubricated antifriction bearings, hydraulic mechanisms, compressor cylinders, and many types of gears. That's one important reason it's the ideal oil for auxiliary plant equipment.

Then Gulf Harmony Oil has outstanding resistance to oxidation and the formation of sludge. In force-feed circulating systems, oil reservoirs, hydraulic systems, and antifriction bearings, Gulf Harmony Oil helps prevent harmful deposits, insures against premature oil changes.

Gulf Harmony Oil also provides a protective film which has preferential wetting characteristics for metal —it displaces moisture, interrupts its corrosive action. Thus Gulf Harmony Oil prevents rust on all oil-bathed surfaces—particularly important in precision hydraulic mechanisms and in antifriction bearings operating under damp conditions. And it separates readily from water, reducing the possibility of emulsification, and prolonging its useful life.

Its high lubricating value means more effective protection against wear under boundary conditions. Available in a wide range of viscosities.

Write today for complete information on Gulf Harmony Oil. Also ask for a copy of the booklet "Gulf Periodic Consultation Service," which tells about Gulf's advanced cooperative service for users of petroleum products. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS

# Better Drainage at *Any* Pressure with Stickle Open Float Steam Traps

Series 100 traps have built in by-pass and strainer. All traps have self-regrinding valve and seat. *Guaranteed* performance. Check this complete line against your drainage requirements—send for *free* bulletins below.

**STICKLE SERIES 100**

A series of traps with a capacity range of 450 to 4,500 lbs. per hour for drainage of smaller units operating at low, medium and high pressures. Built for straight-in-line installation. See Bulletin No. 115.

**STICKLE SERIES AE**

A series of traps with a capacity range of 4,500 to 18,000 lbs. per hour for drainage of larger units operating at medium and high pressures. Multiplies old standard capacities by four. See Bulletin No. 315.

**STICKLE SERIES 50**

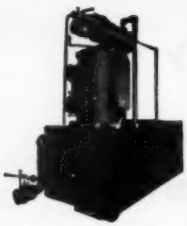
This series of Stickle Traps especially designed for drainage of processing units operating at medium to high pressures creating unusually large volumes of condensate. Capacity standard 8 to 10 times that of standard traps. Capacity range 18,000 to 45,000 lbs. per hour. See Bulletin No. 515.

**STICKLE SERIES T**

A series of traps for drainage of units working at medium and low pressures and to work with vacuum systems. 12 styles and sizes afford a wide range of adaptations and meet a wide range of requirements. See Bulletin No. 415.

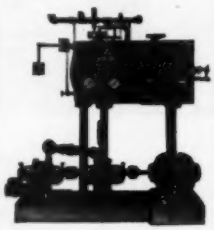
**STICKLE STEAM SPECIALTIES COMPANY**
**2265 Valley Avenue, Indianapolis, Indiana**

**other cost-cutting STICKLE equipment**



**Stickle Open Coil Feed Water Heaters**

**Stickle Regulating and Reducing Valves**



**Stickle Differential Drainage and Boiler Return System**

**FREE!** Get all the money - saving details, complete with illustrations. Write for free Stickle Bulletin Nos. 117 (Heaters), 235 (Valves) and 250 Return Systems). Do it today!


# More EQUIPMENT NEWS

*Begins on page 162*

essing machinery requiring periodic sampling of liquids or venting of air. Valve is brass and steel construction, has a ½-in. male pipe thread for mounting.
**Oil-Rite Corp, 3478 S 13 St, Milwaukee 15, Wis.**

For more data on these items, use post cards, p171. Identify request with P and number.

**PERMANENT MAGNET** **P1142**

A cobalt-platinum magnet, which in small sizes is described as the world's most powerful permanent magnet. Present commercial use of the new magnet is limited, however, not only by government restrictions on cobalt, but by prohibitive expense of the large amounts of platinum in the alloy.

The new magnet will not replace presently used magnetic alloys, such as the Carboloy Alnico magnets but rather new fields of use will be opened, for which existing magnets are not suitable. Compared with Alnico-5 magnets, generally rated as the most powerful in commercial use, the new magnet is less powerful in large sizes but more powerful in small sizes, according to GE scientists.

Laboratory experiments with a new magnet about the size of an eraser on a lead pencil, and a similar-sized Alnico-5 magnet, show the new magnet to have lifting power 24 times greater than that of Alnico-5, and about eight times more resistance to demagnetization.
**General Electric Co, Schenectady 5, N. Y.**

**SPRING COMPUTER** **P1115**

Spring design problems easily solved with *Calculaide* Spring Computer. It correlates in one setting all variables in spring design: OD of the spring, wire size and gage No., No. of active coils, material and its torsional modulus G, maximum shear stress, load and total deflection. All figures are directly read off.
**American Hydromath Corp, 145 W 57th St, New York 19, N. Y.**

**OIL FILTER** **P1143**

High-pressure oil filter for lubricating and sealing oils has a cartridge made of fuller's earth or cellulose through which oil under pressure as high as 1500 psi can be directed. *Hilco* filters come in capacities starting from 1 gpm up to practically any required flow.
**Hilliard Corp, 158 W. Fourth St, Elmira, N. Y.**

**INCANDESCENT "WHITE" LAMP** **P1119**

This 60-watt lamp contains inside "Q" coating that spreads light evenly over entire surface of bulb. Coating is silicon compound that gives near-perfect diffusion.

Benefits of lamps with new coating are that they cast soft shadows, lessen reflected glare, diffuse the light evenly, and have

## Here's Why You Get

# LOWER HIGH-PRESSURE PUMPING COSTS

## with this distinctively new

# Class HMTA

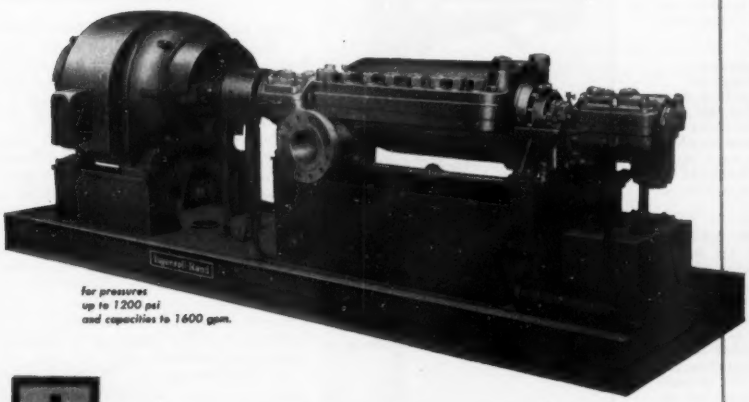
## multi-stage centrifugal pump

Check the many distinctive features of Ingersoll-Rand's Class HMTA high-pressure centrifugal pump. See how they all add up to important long-range savings in installation, operation and maintenance. For here is the completely modern answer to the problems inherent in high pressure pumping service—a pump that's designed around the latest advances in hydraulic engineering.

Operating efficiencies stay higher, longer—because all running clearances are proportioned for minimum wear and materials are carefully selected for dependable performance. Maintenance is easier—and there's less of it—with simpler, more rugged construction and greater accessibility throughout. And spare parts inventories are lower due to increased interchangeability between stages.

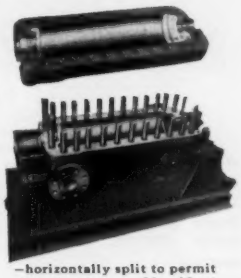
HMTA pumps may be equipped with the Cameron Shaft Seal—and with sleeve or ball bearings, as desired.

Your nearest I-R representative will be glad to give you complete information. Or write for your free copy of Bulletin No. 7233.



*for pressures up to 1200 psi and capacities to 1600 gpm.*

### STRONG, SMOOTH-BORE CASING



—horizontally split to permit access to rotor assembly without disturbing piping connections.

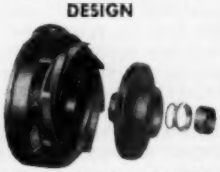
### UNIT-TYPE ROTOR ASSEMBLY

—including impellers, wearing rings, and stationary channel rings with interstage liquid passages. All elements self-aligning, all precision-machined for high sustained efficiency.

### POSITIVE INTERSTAGE SEALING

—at all temperatures and pressures is provided by corrosion-resistant, metallic rings which form the fit between channel rings and casing. These rings form the most efficient, practical seal yet devised, contributing to the higher efficiency of the HMTA.

### MULTIPLE-VOLUTE DESIGN



—assures complete radial balance of impellers over entire range of pump operation.

*These and many other new HMTA features add up to:*

- GREATER DEPENDABILITY
- HIGHER SUSTAINED EFFICIENCY
- LOWER MAINTENANCE COST

**Ingersoll-Rand** CAMERON DIVISION 698-10

11 BROADWAY, NEW YORK 4, N. Y.

CONDENSERS • PUMPS • COMPRESSORS • ROCK DRILLS
AIR & ELECTRIC TOOLS • GAS ENGINES • DIESELS

# OIL AND GAS BURNING EQUIPMENT FOR EVERY INDUSTRIAL APPLICATION

Whether you burn pitch, tar, oil, gas or a combination of these fuels, there's a NATIONAL AIROIL BURNER for your job.

Our more than 38 years' experience in the design, development and manufacture of all types of industrial burners is at your service.

Ask us about your requirements . . . we'll gladly give you full information.

**TYPE "SA"**
(For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring only low oil pressure and temperatures. Send for Bulletin No. 21.

**TYPE "S-A-L"**
(Large capacity burner similar to TYPE "S-A-R") is adaptable in combination with powdered coal burners in large boilers. Send for Bulletin No. 24.

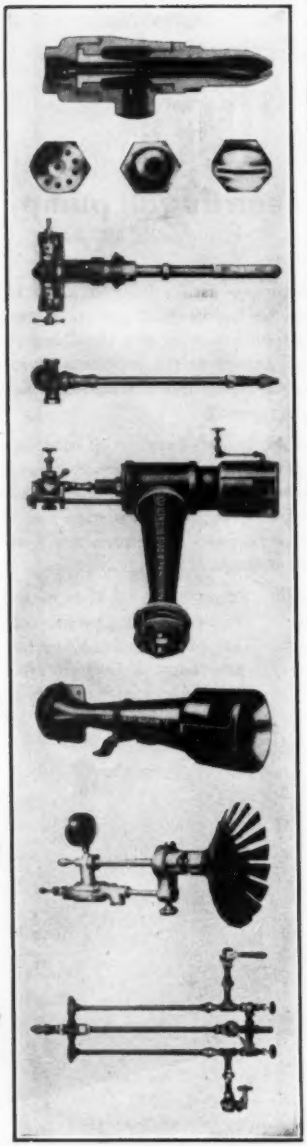
**TYPE "S-A-R"**
(Where steam, or gas is available for atomizing) safely and efficiently burns residuums obtained from process. Send for Bulletin No. 23.

**COMBINATION GAS AND OIL BURNER**
— the "AIROCOOL" Gas Burner in combination with a TYPE "S-A-R" Oil Burner. Send for "AIROCOOL" Brochure.

**"AIROCOOL" GAS BURNER**
(Of venturi type), assures low turndown without burnback. Send for "AIROCOOL" Brochure.

**MECHANICAL PRESSURE ATOMIZING OIL BURNERS**
with multi-vane type air diffuser to give a positive swirl to entering combustion air. Send for Bulletin No. 13.

**TYPE "S-A-D"**
(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors, tars, pitches, etc., in combination with fuel oil. Send for Bulletin No. 21.



## PRODUCTS

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

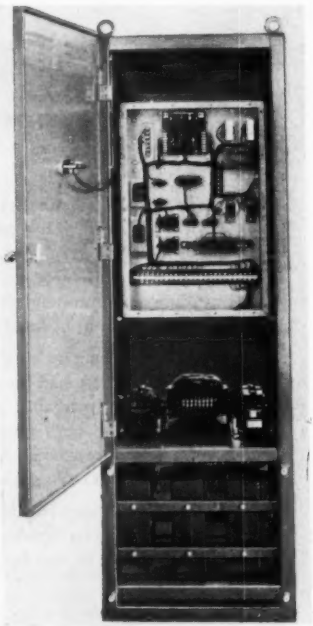
**NATIONAL AIROIL BURNER CO., INC.**
*Main office & Factory:* 1250 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS


# More EQUIPMENT NEWS

Begins on page 162

white, clean appearance. These advantages are said to be provided without appreciable loss in amount of light produced.
**General Electric Co, Schenectady 5, N. Y.**

For more data on these items, use post cards, p171. Identify request with P and number.



## MAGNETIC-DRIVE CONTROL P1101

Magnetic amplifiers adjust output speed of magnetic drives and hold it constant at any set value. Speed is adjusted by difference between a reference voltage, set by a potentiometer, and output voltage of a tachometer generator driven from output shaft of the magnetic drive. This difference is magnified by a 3-stage magnetic amplifier to adjust the magnetic drive field-coil excitation for the desired output speed.

Saturable reactors and selenium rectifiers make the first and second stages self-saturating amplifiers, supplying dc to these stages. Three saturable reactors form the third amplifier stage of the control. These reactors, combined with a 3-phase bridge selenium rectifier, supply dc to excite the magnetic-drive field coils.

A sensitivity of $\pm 0.5\%$ speed regulation is obtained through a current amplification of about 20,000 to 1. Anti-hunt and damping circuits prevent hunting while in stable-speed operation and overrun on speed changes. Control can be applied to magnetic drives on fans, centrifugal pumps, compressors and other applications.
**Electric Machinery Mfg Co, Minneapolis 13, Minn.**

# Burn REFUSE or COAL

## *With* DETROIT STOKERS

**Successful Installations Burn**

Hogged Wet or Dry Bark
Hogged Wood
Wood Shavings and Sawdust
Wood Sander Dust
Spent Tan Bark
Corn Cobs
Coffee Refuse
Oat Hulls
Coconut Shells
Tobacco Stems
Leather Scraps
Peanut Shell Refuse

—Either separately or in combination with coal, oil or gas

The use of the Detroit RotoStoker and RotoGrate Stoker for various kinds of waste materials, followed quite naturally its established use for burning an extremely wide range of Coals, as well as high moisture Lignite.

Through the years, installations with steam boilers of a wide range of types and sizes have been made for burning waste materials.

If you have combustible refuse, the best disposal method is *burning it* which will avoid nuisance or pollution and at the same time will salvage the fuel value.

Detroit RotoStokers and Detroit RotoGrate Stokers are readily adapted and highly successful for refuse burning.

*Write for this 24 page Booklet 505 which gives Engineering data on our refuse burning installations.*

DETROIT SINCE 1898 STOKERS

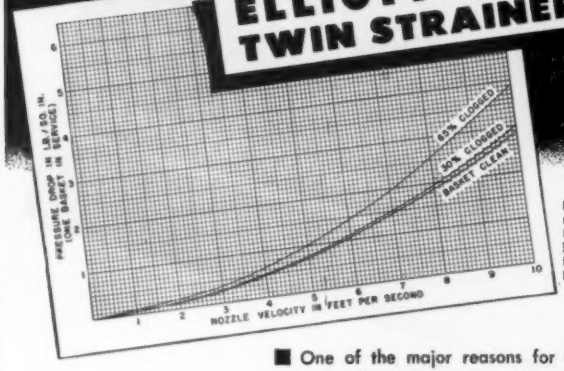
**DETROIT STOKER COMPANY**

**General Motors Building • Detroit 2, Michigan**

***District Offices in Principal Cities • Works at Monroe, Mich.***

# BIGGER BASKETS cut pressure drop

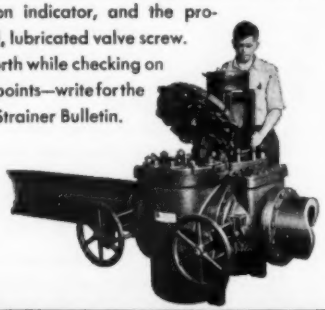
## ELLIOTT type A TWIN STRAINERS




From a test made at the University of Pennsylvania Hydraulics Laboratory.

■ One of the major reasons for the low pressure drop of this recently redesigned line of non-stop strainers, is the generously large basket capacity—a 5 to 1 ratio with standard mesh. Even when clogged with foreign matter to the point where cleaning becomes necessary, the pressure drop is less than 2 feet of water at a velocity of 4.5 feet per second

Maintenance is cut, too. Big baskets mean fewer clean-outs, and the strainer going longer without attention. Other features are the two-way gate valves that really seal, the replaceable valve seats (optional), the easily removable valve disc, the quick-visible valve position indicator, and the protected, lubricated valve screw. It's worth while checking on these points—write for the Twin Strainer Bulletin.



A-309

ELLIOTT COMPANY

Accessories Dept., JEANNETTE, PA.

Plants in JEANNETTE, PA. • RIDGWAY, PA.

AMPERE, N. J. • SPRINGFIELD O • NEWARK, N. J.


## ELECTRONICS

Continued from page 95

cycler element $H_1$ to full voltage of transformer $S$-$S_6$. Cycler's temperature rises so high that the relay cannot pull in and turn on the heat. The relay can close only if the outdoor temperature falls to the heating plant's design temperature for which the full-heat potentiometer $R_{13}$ is set.

At the beginning of the pick-up heating period in the morning the clock starts to move wiper arm $A$ across $R_6$. Resistance in series with cycler element $H_1$ is slowly increased and the cycler gradually cools. When the cycler reaches the pull-in temperature set by outdoor-element temperature, relay $CR$ pulls in and turns on the heat. The relay remains closed during the pick-up period.

As wiper arm $A$ cuts the resistor $R_4$ in series with cycler element $H_1$ the cycler cools. At end of pickup period, arm $A$ has cut all of resistor $R_4$ in circuit and the clock switch trips back to its top contact, placing relay contact $CR_2$ in control of the cycler heater $H_1$ for normal cycling. Heat will remain on after the pick-up period until the cycler's temperature rises to drop-out point of relay $CR$ set by the existing outdoor temperature.

This type of control may be applied to any type of heating system for which 2-position control is suitable. Direct control of the burners may be considered the normal method of application. Direct steam requires a valve, but is otherwise like direct burner control. Zone control applications may sometimes be desired, either by valves or cycling of zone circulators.

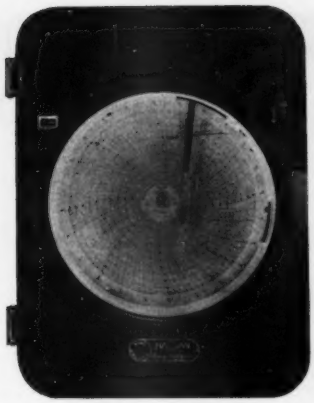
## WITH OUR READERS

Continued from page 5

great country. One reason I think this may happen is that you were attracted by an editorial that stressed the practical side of engineering.

In engineering, as in other matters, India has been a land of thinkers and mystics, rather than of doers. Yet there is no possible solution for the misery, hunger and poverty of the Indian masses except a rising generation of young men who will apply practical technical know-how to the problems of power, production, agriculture, distribution and sanitation. May you be one of those who will bring these priceless gifts to your native land.

I thank you for reminding me that the editorial you mentioned appeared in *Operating Engineer*, and is, therefore, unknown to the many thousands of present POWER readers. Because I want all these others to know how I feel about engineers, I repeat my views, p 75 of this issue.—*Phil Swain*



*measuring flow of*
*water–*
*steam–*
*air–gas–oil–other fluids?*

*then use dependable* HAGAN

# RING BALANCE FLOW METERS

There are many reasons why you get dependable records from Hagan Ring Balance Flow Meters. These include utilization of the sound radial torque principle which is simple and reliable over a wide range; high torque-to-friction ratio; ease of dead weight calibration, and

- **No stuffing boxes**
- **High sensitivity at low flow rates**
- **Adjustable full scale range**
- **Mercury level not critical**

An economical feature of all Hagan Ring Balance Meters is that maintenance costs are low. For more information on how versatile Hagan Ring Balance Flow Meters will answer your metering problems, write to the Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

## HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters.
I am particularly interested in .....

.....

NAME .....
POSITION .....
COMPANY .....
STREET AND NUMBER .....
CITY ..... ZONE ..... STATE .....

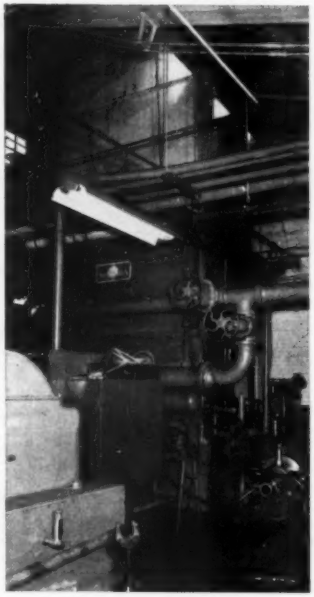
P-11

# You Get Trustworthy Liquid or Gas Cooling With Great Cooling Water Savings from the NIAGARA AERO HEAT EXCHANGER

● You can cool air, gas, water, oils, chemicals, electric and power and process equipment, engines, mechanical processes with lower cost and really accurate control of temperature with the Niagara Aero Heat Exchanger.

You are assured of uniform, constant production and quality from any process . . . steady, reliable operation . . . lower cost for more dependable cooling. You can have closed system cooling with freedom from scale, dirt, corrosion and maintenance troubles. You can accurately cool more than one type of liquid with one machine.

The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases by evaporative cooling. You can remove heat at the rate of input to keep accurate control of gas or liquid temperature. You can put heat back into the system to save the losses of a "warm-up" period or to equalize the effect of load variations.



Great savings in cooling water and savings in piping, pumping and power return the cost to you quickly. The Niagara Aero Heat Exchanger can save you approximately 95% of your cooling water cost. Write for Bulletin 96.

**NIAGARA BLOWER COMPANY**

Over 35 Years Service in Industrial Air Engineering

**Dept. P, 405 Lexington Ave. New York 17, N. Y.**

*Experienced District Engineers in all Principal Cities*

*(Advertisement)*


# BOOKSHELF

**Pump Engineering Data Book** *(1952—7th edition). 417 pp, 5x8½ in, illust, tables, semi-flexible. $3. Economy Pumps, Inc, Sedgley Ave at 19th & Lehigh St, Philadelphia 32, Pa.*

Those interested in application of centrifugal pumps find here wealth of information on practically every phase of pumping. Opens with discussion of centrifugal pump characteristics, pump testing and priming methods. Considerable emphasis is placed on specific speed and how it influences shape of pump impellers and performance curves. Attention is given to the proper installation of pumps, not only for handling water but also other liquids.

Much information is presented in tables. These include specific speed, friction of water in pipes, discharge through nozzles, properties of steam, properties of metals and alloys, experience with pump materials and liquids, motor size, efficiency and wiring tables, water rates and cost of pumping. Specific attention is given to selecting pumps for building drainage and water-supply systems, swimming pools, boiler feed, paper stock, sugar refineries, and many other industrial applications. Closes with a large section giving data on the different types of pumps the company builds.

**Civil Defense in Modern War.** *(1951). By A M Prentiss, Brig Gen U.S. Army (ret). 429 pp, 63 illust, $6. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 18, N. Y.*

Gives methods of protecting civilian population against atomic, bacterial and chemical warfare. Part I deals with modern air warfare and types of aircraft as well as pilotless bombers and guided missiles. Each of these could pursue the three types of warfare. Destruction agents' potentialities and limitations are discussed.

Part II covers civil air defense, and its various forms—methods of protecting industries, communities, homes and people. Combinations of protective measures are stressed.

Part III discusses organization of civil defense. Complete guide to programs for national, state and local governments. Warden, health, medical and special weapons defense services are included. Paramount importance of local governments and individual citizens in establishing maximum security becomes unmistakable. Shows why need of organized civil defense must be brought home to all.

**Standard Practices for Low- and Medium-Speed Stationary Diesel Engines** *(1951—4th edition). 197 pp, 6x9, illust, cloth. $5. Diesel Engine Mfrs Assn, 1 N LaSalle St, Chicago 2, Ill.*

Member companies of the Association coordinated engineering and sales departments to rewrite the former edition. Covers engines running at 750 rpm or less.

Subjects include engine construction, governors and speed regulation, torsional vibrations and critical speeds, intake and

Photos Courtesy The Austin Company
Engineers and Builders

# 4 UNION BOILERS *at* THE UPJOHN COMPANY

*Fine Pharmaceuticals Since 1886*

**KALAMAZOO 99, MICHIGAN**

EACH of these 4 coal fired Union "A" Type Boilers delivers 60,000 lbs. of steam per hour 175 psi—sat., for heat and process requirements at the new Upjohn Plant on Portage Road, Kalamazoo, Michigan. Their design provides for gas or oil firing if necessary. The Upjohn selection charges these Union Boilers with supplying steam for some 33 acres of modern plant under roof, where over 700 world-famous Upjohn pharmaceuticals are produced. Known for fine pharmaceuticals since 1886, Upjohn selects every unit upon which production depends with critical eyes. You can fully depend upon Union to furnish correct steam generating units for your specific requirements. You will profit by consulting with Union engineers.

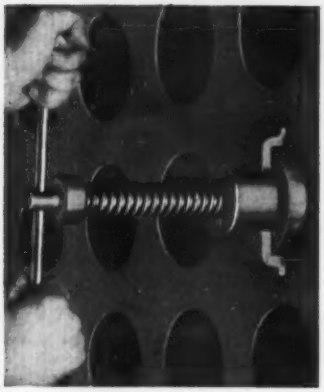
The Upjohn boiler plant building is designed to accomodate 2 more boilers when needed. The 50 ton per hour coal bunker overhead is designed with weigh-larry to serve boilers on both sides of the boiler room.

**UNION IRON WORKS . . .** *Since 1890*

**373 CASCADE STREET • ERIE, PENNA.**

**BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL**

# 48 man-hour job done in only 4 hours with a ROTO Hand-hole Seat Scraper



*Illustrating ease of operation of Roto Hand-hole Seat Scraper.*

If you operate any of the boilers listed below, you can't afford to be without a ROTO Hand-hole Seat Scraper.

A Pennsylvania manufacturer reports that it formerly took three men 2 to 3 days to clean inside cap seats on a Keeler Boiler header. Now, with a ROTO Hand-hole Seat Scraper, one man does it in four hours, besides doing a better job.

This simple, hand-operated tool is equipped with retractable knives mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Write for bulletin and prices.

| MAKE OF BOILER | TUBE SIZE | OPENING |
|---|---|---|
| Babcock & Wilcox | 4" | Oval |
| B. & W. No. 40 Header | 3¼" | Oval |
| B. & W. No. 41 Header | 2" | Oval |
| B. & W. Superheater | 2" | Round |
| Babcock & Wilcox | 4-13/16x5" | Square |
| Casey Hedges | 4" | Oval |
| Casey Hedges | 3½" | Oval |
| Combustion Engineer'g | 3" | Round |
| Edge Moore | 4" | Oval |
| Franklin | 4" | Round |
| Geary | 4" | Oval |
| Heine | 3½" | Oval |
| Heine | 3½" | Round |
| Keeler | 4" | Round |
| Keeler | 4" | Diamond |
| Murray | 4" | Oval |
| Murray | 3½" | Oval |
| Oil City | 4" | Oval |
| Oil City | 3½" | Oval |
| Union Iron Works | 4" | Pear Shape |
| Walsh & Widener | 4" | Oval |

*ROTO Hand-hole Seat Scraper for Heine Boiler.*

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.


## More BOOKSHELF

Begins on page 196

exhaust systems, heat-recovery apparatus, starting systems, cooling-water systems, lube-oil systems, fuel storage and handling, generators and electrical equipment, selection of engine size, plant buildings, engine erection, tests, specifications, invitations for bids, operation and maintenance.

The book should be useful to consulting engineers, buyers, users and manufacturers of diesel engines and equipment. It is also a good reference for colleges and universities teaching mechanical engineering.

**The Fundamental Aspects of Lubrication** *(Academy Annals, Vol. 53, Art. 4, 1951). A compilation of 13 papers by recognized authorities. 241 pp, 6x9, paper covered. $4. Published by New York Academy of Sciences, 2 E 63rd St, New York 21, N. Y.*

An important monograph in the field of lubrication dealing with basic problems and recent research in those problems. Following the general papers on full-fluid and thin-film lubrication, it presents investigations on various aspects of surface films in relation to solids; influence on friction, adhesion and surface damage; influence of roughness and oxidation; adsorption; viscosity and molecular structure.

Other papers in this book include studies on the metal-cutting process and cutting-fluid action and on use of large metal crystals as an aid in lubrication research.

**Ion Exchange Resins** *(1951—2nd printing). By Robert Kunin and Robert J Myers, Rohm and Haas Co. 212 pp, 6x9 in., 104 illust, 20 tables, cloth. $4.75. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Development of high-capacity, specific and durable ion-exchange resins has greatly increased applications of ion exchange in industry. Correlates scattered literature on the subject. Serves as reference for all engineers interested in different phases of ion exchange and applications of specific resins.

It is not confined to cataloging literature and applications, but goes back to fundamental theory. Embraces the mechanism of ion exchange and usefulness of ion-exchange resins in specific applications.

Function of ion exchangers is being recognized as a valuable unit operation like filtration and distillation. Includes a description of all types of ion-exchange methods. Considerable previously unpublished data have been released from the author's files.

**Practical Electricity and Magnetism** *(1951). By Maurice Rubin. 356 pp, 5½x9, illust, $7.50. Chemical Publishing Co, 212 5th Ave, New York, N. Y.*

The author tried to keep material on a truly elementary plane, and he has largely succeeded without glossing over important basic concepts. Laymen, along with busy engineers and students, are foremost in the author's mind. No concepts are discussed unless they can be grasped with only an elementary knowledge of mathematics.

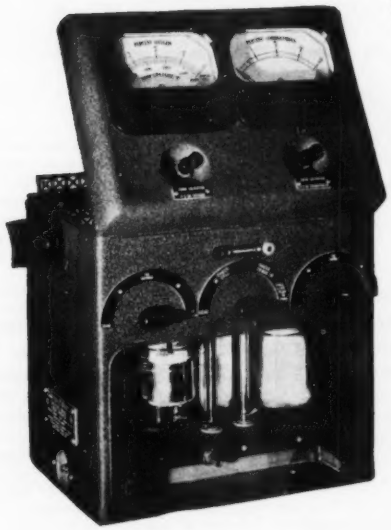
He starts with an explanation of electrostatics, continues through electric charges in motion, meters and measurements, mag-

# Mobilizing BTU's

Now that the "heat's on" for record production, the calls are increasing for the services of the Cities Service Heat Prover. This scientific instrument gives an accurate, instantaneous and continuous picture of combustion conditions in all types of furnaces.

You'll readily be able to calculate any oxygen excess, waste combustible matter, and potential fuel savings. The results are like an accurate "diagram" of corrective measures needed to conserve heat units for consistently higher production at lower cost.

You'll see profit in applying the Cities Service Heat Prover . . . *not an instrument you buy, but a service we supply!* Call or write your local Cities Service office about arrangements. Or simply return the coupon today.



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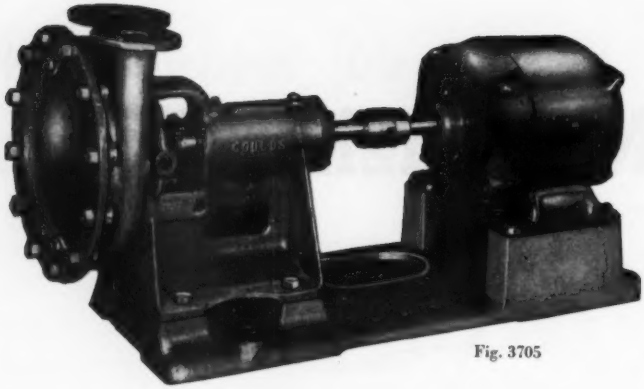


Fig. 3705

# For Outstanding Service Handling Corrosive Liquids—

## Goulds new stainless steel centrifugals

**ADVANCED PUMP DESIGN—**

The Goulds 3705 stainless line represents the last word in effective design. Fig. 3705 pumps will give you efficient, dependable, 24-hour service in handling corrosive liquids—at low cost.

**CAPACITIES—**

Goulds stainless steel centrifugals are made in 9 sizes with capacities to 750 G.P.M. and heads to 180 ft. depending upon capacity.

**ADVANTAGES—**

Exceptional efficiency (see Bulletin for performance curves) plus extreme simplicity make this an ideal pump for corrosive applications. High interchangeability of parts cuts stocking problem. Quick inspection or cleaning—simply remove casing cover without disturbing pipe connections.

MEMBER

*Write for Bulletin 725.3 for complete details on this new stainless steel pump.*

Goulds PUMPS INC.
Seneca Falls
New York

## More BOOKSHELF

Begins on page 196

netism, electronics, electrical conductions in gases, practical applications including both power and electronics (radio and television). Final chapter is devoted to recent developments.

For instance, take Chapter II, Speed of Electric Current. An analogy is drawn to a group of men moving in single file at 2 miles an hour. At a certain signal, while they are advancing, last man in line taps the one ahead. Instruction is to tap the man ahead of him when he feels himself tapped. Even though the men move at only 2 miles an hour, tapping will travel through whole file in a few seconds. And so it is with current flow. Free electron at one end of wire doesn't speed through conductor at 186,000 miles a second. But impulse produced by movement of the free electron does travel at speed of light.

The reader with no electrical background may run into trouble at a few spots. This is bound to happen in attempting to cover a broad field in one book.

**Internal-Combustion Engines** *(1950—6th edition). By Lester C Lichty, professor of mechanical engineering, Yale University, 598 pp, 6x9, 461 illust, many charts, cloth. $7. McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y.*

This thorough revision takes account of recent developments; more difficult parts have been simplified and some old data eliminated. Material added covers newer types of fuels and engines, including rockets and other units.

An outstanding feature is the strongly underlying thermodynamic treatment for various energy processes. Analysis always starts with energy equation for the process. Analysis is simple and made easy to solve by data in tables or graphs.

Major topics include the combustion process, air-standard cycle analysis, fuels, combustion knock and knock rating, carburetion and fuel injection, manifolds and mixture distribution, valves and valve mechanisms, charge ignition, combustion-chamber design, engine lubrication, heat transfer and engine cooling, performance, vibration and balance, and engine design.

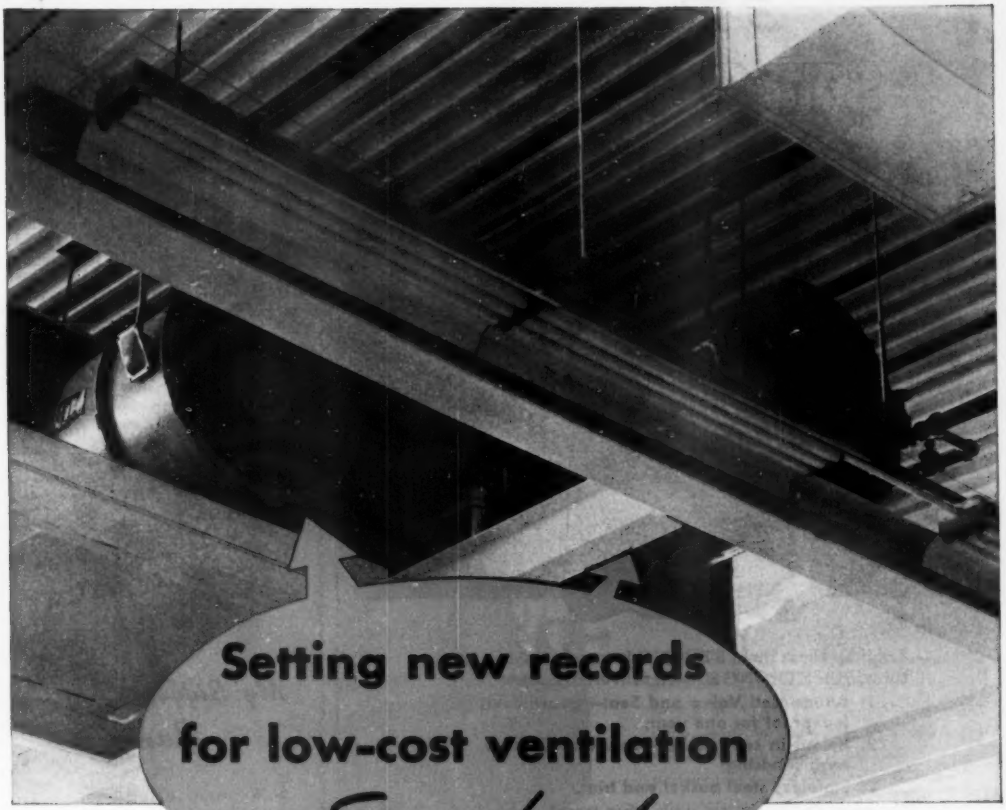
For serious students of internal-combustion engines and all engineers who'd like to know more about how and why their engine operates.

**High-Speed Diesel Engines** *(1950—6th edition). By P M Heldt, 500 pp, 5¼x8¼ in., illust, cloth. $6. P M Heldt, Nyack 9, N. Y.*

This up-to-date discussion of the modern diesel engine covers theory, design, application, operation, maintenance and fuels. Illustrations include large-scale sectional drawings of complete engines.

Chapters on thermodynamics of the diesel cycle, combustion phenomena, fuels, fuel injectors and sprays, injection pumps, governors, precombustion-chamber engines, turbulence-chamber engines, auxiliary-chamber engines, 2-stroke engines, supercharging, lubrication and gas turbines are included.

Graphical analyses are particularly clear and of much interest to engine designers



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# JOY AXIVANE* FANS

WITH JOY AXIVANE Fans, you profit by the greater efficiency, quieter and smoother operation, and lower power consumption of their vaneaxial design. You save on installation, too. These light, compact, in-line fans mount directly in the air duct—saving space and time, making foundations, guards, etc. unnecessary. What's more, the important adjustable-blade feature of JOY Fans gives you extra flexibility—permits easy adjustment on the job to suit new conditions or compensate for faulty duct work. ● Let us show you how to get *best* ventilating results!

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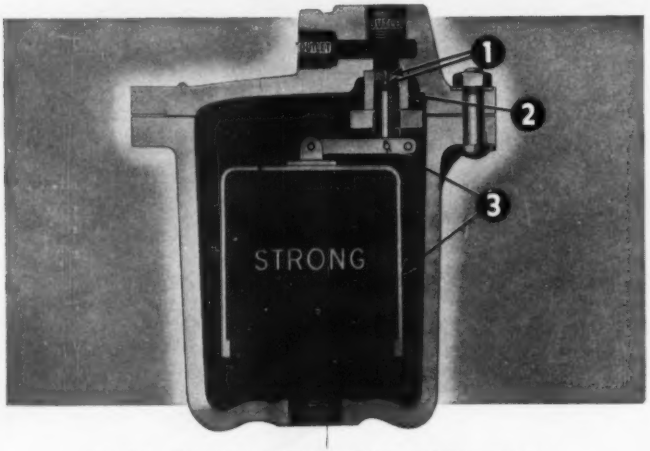
IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

# 3 Reasons STRONG* Traps are easy to maintain!




Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-P describes inverted, open bucket and other types of STRONG traps. Write today.

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**STRONG, CARLISLE & HAMMOND COMPANY**

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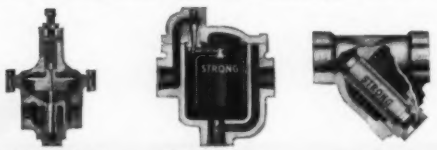
ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES




Reducing Valve | 70 Series Trap | "SY" Strainer

STRONG


# More BOOKSHELF

Begins on page 196

and chief operators. The book should be of most use to men designing and operating high-speed engines.

**Nomographic Charts.** *(1951). By C A Kulmann. 244 pages, charts and text, 10x7½. $6.50. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 18, N. Y.*

Collection of 92 charts for calculating quantities used in various branches of engineering. Fields covered — mathematics, geometry, hydraulics, mechanics, thermodynamics and electricity. Of value to engineers who make large number of repetitive calculations with rather complicated formulas. Large page size allows satisfactory accuracy for practical purposes. Each chart accompanied by description of how to use for calculation. In most cases basic formula on which chart is constructed is also given.

## My Biggest Boner

► WE WERE HAVING TROUBLE with the steam trap on the steam line leading to our feedwater heater, so I was sent on top of our two hrt boilers to take the trap off the line and find the trouble. But trouble found me first.

After closing the gate valves on both sides of the trap, I proceeded to remove the unions. The union collars came off easily, but I had some trouble separating the lines.

So I gave the lines a few heavy blows . . . and they separated all right . . .

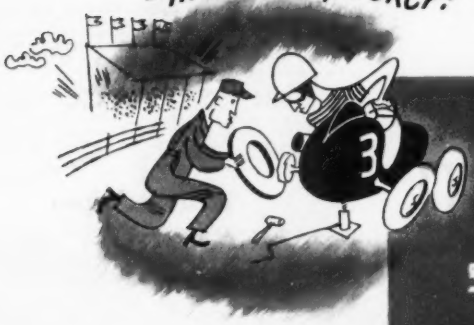
But steam roared out of the break, the line shook so hard that it snapped off at the main steam outlet and both boilers had to be shut down for the repair.

I still carry the scars of the burns and bruises I got. They're a pretty good reminder to *open the drain cock before removing a steam trap that's been under pressure.*

JOSEPH DEDYNA
*Kitchener, Ont.*

• What is your "biggest boner"? We'll pay ten dollars for each one we publish

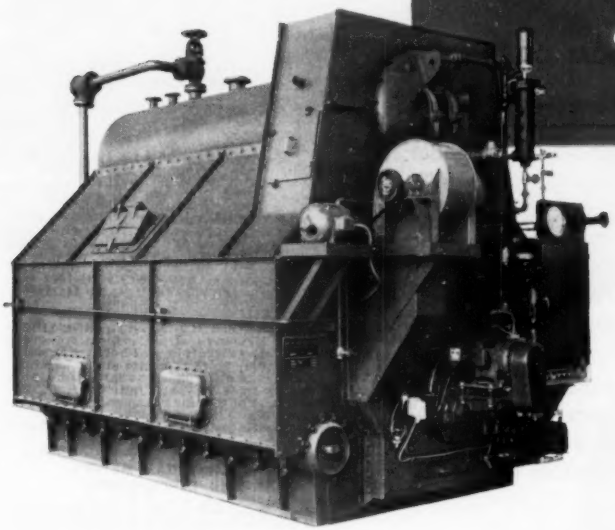
-in action quicker!



# WICKES

## shop assembled power

FOR YOUR STEAM GENERATING NEEDS



Steam power in a compact, efficient shop-assembled unit, custom-engineered to your exact steam generating requirements, ready for immediate installation! Wickes Type A Steam Generator is a steel-encased unit complete with baffles, refractories, pressure parts and firing equipment, designed to conserve headroom and floor space. Each furnace wall is a separate steam generator as well as an integral part of the boiler. There are no complicated headers or circulating tubes to require frequent maintenance or repair. Wickes Type A shop-assembled boilers are engineered for pressures up to 900 psi. with sustained steam production up to 35,000 lbs. per hour at 20 to 330 nominal h.p.

Wickes can also fill your requirements for steam generators up to 250,000 lbs. per hour and 950 psi. — all types of multiple drum boilers adaptable to any standard method of firing, oil, gas, single retort underfeed or spreader stoker. Write today for descriptive literature on Wickes complete line of steam generating equipment or consult your nearest Wickes representative.

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# CORAVOL

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# Protection (FROM CORROSION)

## Because CORAVOL Circulates to Control Corrosion

**CORAVOL** circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

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**CORAVOL** IS PART OF A COMPLETE TECHNICAL SERVICE which provides special chemical formulas for: boiler feed water . . . foam prevention . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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# More FREE BULLETINS

Begins on page 171

**B31** **SPEED REDUCERS** — Gear motors. How to select; hp ratings, rations, installation graphs, replacement parts. 96 pages; pocket-sized catalog. Abart Gear and Machine Co, 4834 W 16th St, Chicago 50, Ill.

**B32** **LIGNUM - VITAE**—For bearings, bushings, pulleys, rollers—substitutes for metals and plastics. Uses, properties, availability. 4 reprint articles, 4-page bulletin, 12-page pamphlet. Lignum-Vitae Products Corp, 91-97 Boyd Ave, Jersey City, N. J.

## METALS AND ALLOYS

**B33** **CASTINGS**—Light and medium: gray, alloyed, and Meehanite irons; Ni-Resist. 48-page booklet illustrates types of castings, finishes, uses. Hamilton Foundry and Machine Co, 1551 Lincoln Ave, Hamilton, Ohio.

**B34** **COPPER**—History of Paul Revere, founder of U. S. copper industry. Development and present products of Revere Copper and Brass. 48-page booklet. Revere Copper and Brass Inc, 230 Park Ave, New York 17, N. Y.

## ELECTRIC METERS AND INSTRUMENTS

**B35** **ELECTRONIK RECORDER**—Frequency recorder for electrical power production. Photos, specifications, circuit diagram. 110-125 v, 60 cycles. 2-page data sheet No 9.1-1-8. Minneapolis-Honeywell Regulator Co, Station 40, Wayne and Windrim Aves, Philadelphia 44, Pa.

**B36** **CURRENT TEST UNIT**—Supplies any current from 0 to 500 amp. For testing and calibrating overload relays, circuit breakers, transformers, instruments, relays. Photos, specifications. 2-page bulletin No. C-1003-351. Multi-Amp Corp, 121 Cross St, Harrison, N. J.

**B37** **RECORDING OSCILLOGRAPH**—Measures strain, vibration, pressure, acceleration. Photographically records up to 18 separate static or high-frequency phenomena at same time, plus timing lines. 16-page bulletin No. CEC-1500B. Photos, diagrams, specifications. Consolidated Engineering Corp, 300 N Sierra Madre Villa, Pasadena 8, Calif.

## MECHANICAL METERS AND INSTRUMENTS

**B38** **PYROMETERS AND PYROMETER CONTROLLERS**—For temperatures to 4000 F. Wall, switchboard, and flush panel mounting, for gas, electric and oil-fired furnaces. Bulletin No. P1244. Bristol Co, Waterbury 20, Conn.

**B39** **pH MEASUREMENT AND CONTROL**—Recording and controlling instruments. Glass and calomel electrodes for immersion and flow uses. Specifications, applications, illustrations. 24-page bulletin No. pH 1302. Bristol Co, Waterbury 20, Conn.

**B40** **PRESSURE TRANSMITTERS** — 4 types: Bourdon tube (15-10,000 psi); gage pressure bellows (0-10, -200 in. water); absolute (0-50, -30 in. mercury); differential (0-20, -300 in. water). Use with standard recorders and indicating instruments. Application, operation, wiring diagrams. Four 4-page bulletins, No. 61, 69, 70, 71. Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa.

**B41** **DIFFERENTIAL CONVERTER**—Pneumatic balance - type flow transmitter. Continuous range change adjustment from 0-20, to 0-200 in. water. Specifications, installations, operating principles. 16-page catalog No. 2281. Minneapolis-Honeywell Regulator Co, Industrial Div, Station 40, Philadelphia 44, Pa.

**B42** **PORTABLE ANEMOMETER**—Instantaneous direct readings of air

(Continued on page 208)

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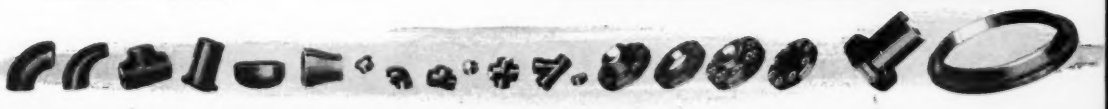

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# Better PRODUCING BOILER

AT LESS COST TO OPERATE . . . .

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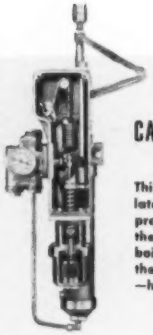
## CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS



### CASH STANDARD FUEL FEED CONTROLLER . . .

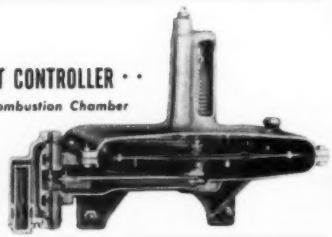
*Automatically Regulates Fuel Feed*

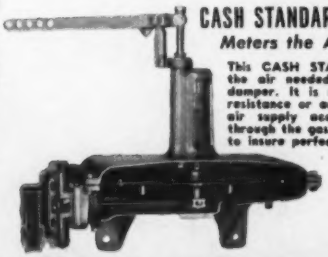
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

### CASH STANDARD FURNACE DRAFT CONTROLLER . .

*Maintains a Constant Draft in the Combustion Chamber*

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.





### CASH STANDARD AIR FLOW CONTROLLER . . .

*Meters the Air Needed for Combustion*

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

Write today for Bulletin No. 300.

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AUTOMATIC REGULATION OF FUEL FEED

METERED AIR NEEDED FOR COMBUSTION

A CONSTANT DRAFT MAINTAINED IN THE COMBUSTION CHAMBER

**3. REALIZE**

MORE STEAM FROM YOUR PRESENT BOILER

LESS FUEL - COAL - OIL - GAS
LESS COSTS
SAVINGS IN MAINTENANCE . .

*whether you have a single boiler or battery of boilers*

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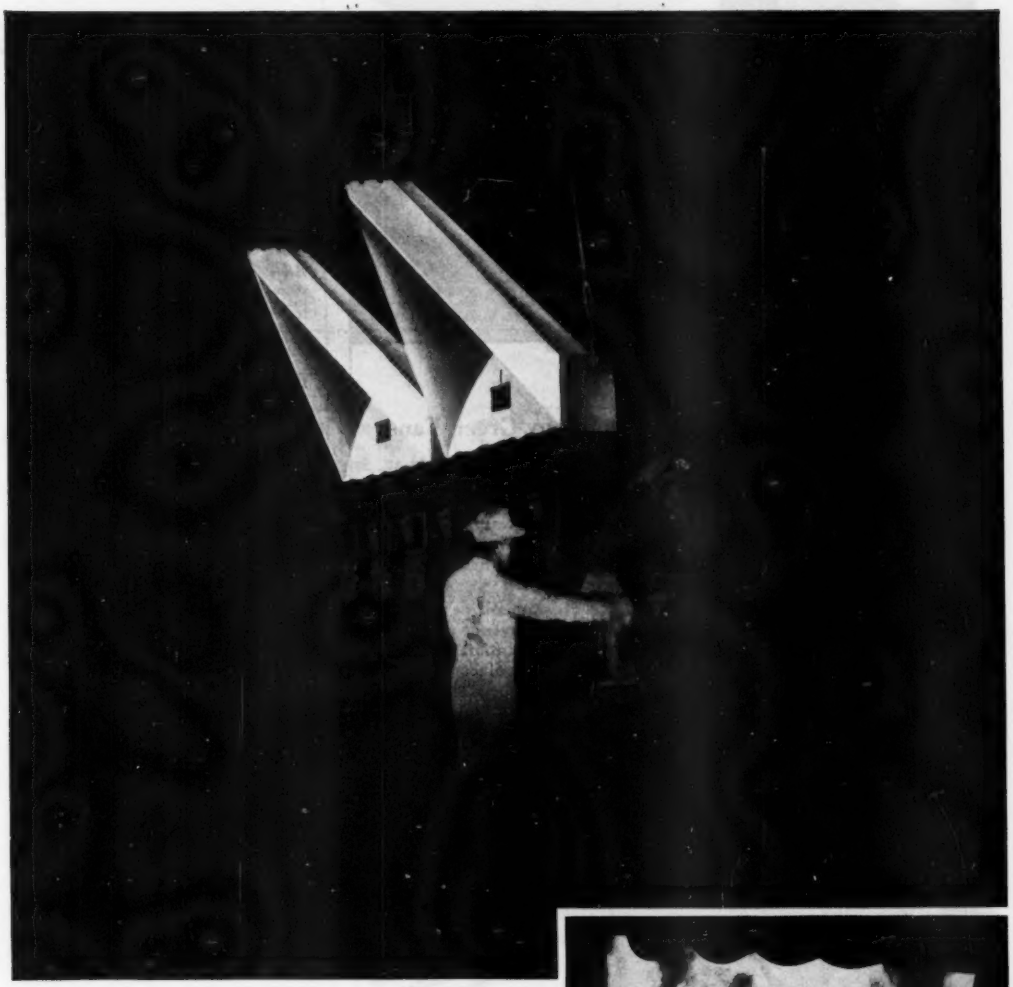
**CASH STANDARD**
CONTROLS . . VALVES

# S-E-Co. Conical Distributors Prevent Coal Segregation



**S-E-Co.** CONICAL Non-Segregating Coal Distributors definitely prevent segregation on stokers. Note the top insert to the right which shows fire with coal segregation on a chain grate stoker. The two fine coal streaks produce smoke. Here the coke does not completely burn out before it is dumped into the ash pit. The three streaks of coarse coal allow large quantities of excess air into the furnace.

The lower insert to the right shows the same stoker after the installation of a CONICAL Non-Segregating Coal Distributor. Note the even burning of the fuel bed which assures higher average $CO_2$, lower combustible in the ash, greater fuel burning capacity of stoker and lower maintenance of stoker and arch.

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**Engineers whose responsibility it is to recommend or accept draft fans for large power plants certainly want efficiency and low operating costs. But they don't overlook the maintenance and replacement angles. They want the sound designs of competent experienced fan engineers. They also want the care in construction that is found in shops of a company that has built up an international reputation as the "authority" on draft fans. They know that such a company will not tolerate sloppy shop work.**

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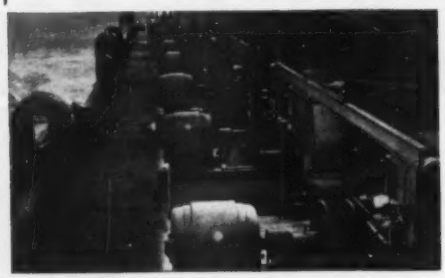

Have You a Copy of Our Fan Bulletin No. 168? If not, we shall be glad to send you one.

THE GREEN *Fuel Economizer* COMPANY INC.

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# More FREE BULLETINS

Begins on page 171

velocity from 0 to 6000 fpm. Operates from temperature differences. 2-page **Air Meter** bulletin. Also **Compensated Thermal Anemometer and Flow Meter,** AIEE reprint, 12 pages. Hastings Instrument Co, Inc, Hampton, Va.

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(Continued on page 240)

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For desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to any operating requirements.

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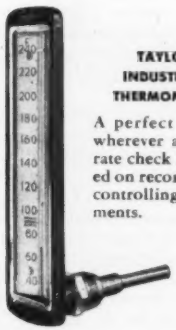

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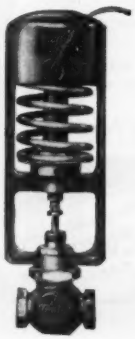

**TAYLOR SELF-ACTING TEMPERATURE CONTROLLER**

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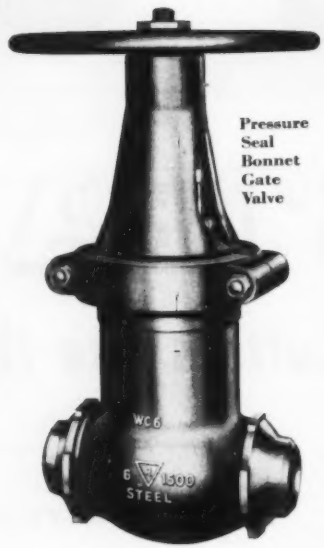


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R-P & C VALVE DIVISION
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READING-PRATT & CADY VALVES

## WATER SOFTENERS

Continued from page 85

for the calcium and magnesium of the raw water, no decrease in the total dissolved solids content takes place. Nor is the raw water's natural alkalinity affected at all. Because hardness developing in the boiler water following an efficient softener operation is usually maintained quite low, and its precipitation consumes little alkalinity, the greater portion of the feedwater's alkalinity remains free to concentrate in the boiler water. What's more, the higher the feedwater's alkalinity content, the closer the alkalinities of the boiler water approach the theoretical proportions expected on direct concentration of the feedwater. So unless raw water is exceptionally low in alkalinity, or average volume of condensate recoverable is unusually large, alkalinity concentrations developing in the boiler water will probably exceed desired levels. Increasingly high alkalinities make foaming and subsequent carryover of solids with the steam more likely. All you can do is go to a higher rate of blowdown or to periodic bypassing of the softener and introduction of raw water directly into the boiler. In this way you can consume some of the concentrating alkalinity with an increase in hardness.

Where the loss from increased blowdown would be intolerable or the demanded rate impracticable, a decrease in raw-water alkalinity must take place along with the hardness removal. Acid treatment or a supplementary hydrogen zeolite softener will do this job.

**Alkalinity Control.** Raw-water alkalinity ordinarily consists wholly of bicarbonates. So a sodium-zeolite effluent generally has its alkalinity entirely in the form of sodium bicarbonate. In the after-acid-treatment of the softened water, this weakly alkaline compound is neutralized with cheaper sulfuric acid. The sodium bicarbonate breaks down, releasing carbon dioxide gas and leaving in solution harmless sodium-sulfate salt, Fig. 4. The softener effluent's bicarbonate content cannot be fully destroyed because severe acid attacks would develop. But it should be cut back to where concentrating alkalinities of the boiler water remain within a predetermined desirable range for normal blowdown.

What can you do about the carbon-dioxide gas saturating the acid-treated water? Either aeration or heated action will expel this gas, aeration being preferred. After adding acid, the water can be circulated through a baffled retention chamber where compressed air bubbles up rapidly from an overspreading floor network. Or a miniature forced-draft cascade tower can be employed, wherein the water trickles over staggered

# YOUR DE LAVAL PURIFIER GIVES DOUBLE PROTECTION, TOO

De Laval protection to turbine lubricating systems is ***double*** because it removes ***both*** of the impurities that contaminate turbine lubricating oil. Centrifugal force is the purifying agent, throwing dirt out of the oil and storing it out of the zone of purification in the bowl, simultaneously separating out any water present and discharging it continuously.

De Laval centrifugals have another advantage—they never remove oil-soluble additives. Of course, additives that are soluble in water will eventually be lost with the removed water, whether the removal is effected by centrifugal force or filters. Since very little water is usually present in the average turbine lubrication system, the amount of inhibitor that is lost is inconsequential. However, the De Laval Oil Purifier has the necessary capacity to take care of a major water leak in the system—an added protection that only a centrifuge can provide.

Write for Bulletin TU 1-8.

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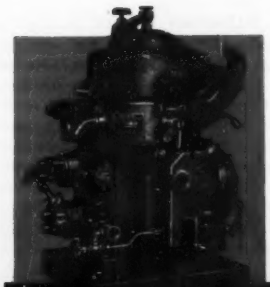


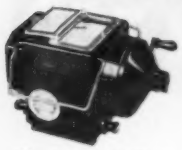
# DE LAVAL

LUBRICATING OIL PURIFIERS

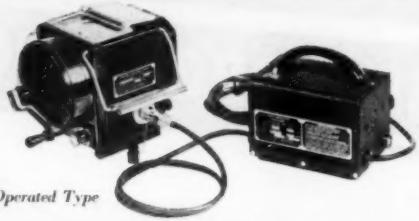
# BIDDLE

NUMBER 6 OF A SERIES

## Instrument News



*Hand-Operated Type*



*Dual-Operated Type*

*Rectifier-Operated Type*

### MEGGER® ELECTRICAL INSULATION TESTERS in Types to Suit Varying Needs For Shop and Field

There's a Megger instrument to suit any set of conditions in shop or field, or a combination of both. The types shown here were born out of the actual experiences and requirements of practical electrical engineers and maintenance men, who found in the James G. Biddle Co. a personal interest in their electrical insulation checking problems.

*The Hand Crank* Meg Type of Megger Insulation Tester is a reliable field instrument, light, sturdy, with constant-voltage type generator—no dependence on batteries or other current supply. Ranges to 2000 megohms, hand generators to 1000 volts d-c.

*The Rectifier-Operated* Meg Type of Megger Insulation Tester covers the same ranges as the hand crank model. It is most efficient for bench work—long tests or repetitive tests of a "production line" nature because it operates from a built-in rectifier that plugs into a convenient outlet.

The most versatile of the Megger family of instruments is the *Dual-Operated* Meg Type of Megger Insulation Tester. This can be a field instrument with hand crank, or instantly converted into a rectifier-operated instrument by handy plug-in rectifier connected to 115 v. 60 cycles outlet. Same ranges as other Meg Types.

*For a complete picture of the Biddle line of Megger Instruments write for Bulletin 21-05-P.*

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Available in 5 range scales from 0-300 to 0-3000 ohms. Furnished complete with test leads and reference ground rod. Dimensions of instrument are 5" x 9¼" x 6¼". Weighs about 8 lbs.

*We shall gladly furnish to responsible prospects the names of companies who have adopted these handy instruments for field crews. Write for list "P" . . . also Ground Tester Bulletin 25-P, and "Grounding Electric Circuits Effectively" by J. R. Eaton (Bulletin 25T2-P).*

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ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT


## WATER SOFTENERS

*Continued from page 210*

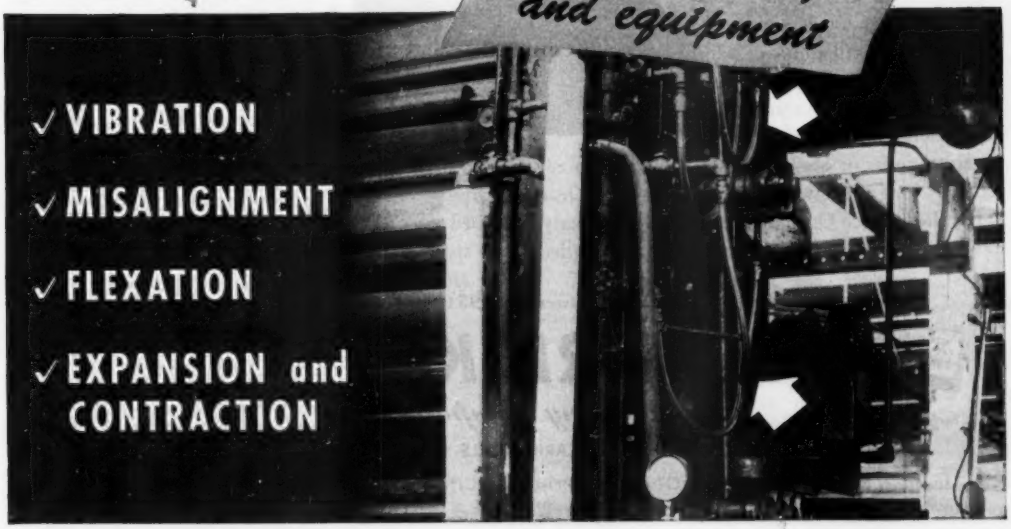
slats counter to a strong current of air blown from beneath. Deaeration must, of course, still follow to give a virtually oxygen-free feedwater.

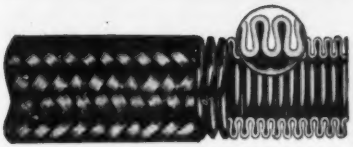
Acid treatment of softener effluent gives you a chance to prevent corrosion in the condensate-return system. You can get rid of most of the highly corrosive-free oxygen carried in raw water by proper deaeration of the feedwater. Then any residual dissolved gas that escapes heater action can be handled with correct chemical follow-up. Deaeration also rids the feedwater of much of its free carbon-dioxide gas. In fact, good deaeration alone pretty well curtails corrosion in the return lines. But where feedwater alkalinity is fairly high, breakdown of bicarbonate in boiler water releases considerable carbon-dioxide gas with the steam, Fig. 5. This, in turn, depresses the pH value of the condensate and greatly increases its corrosiveness. Here you need acid treatment to destroy a vast part or even the entire natural bicarbonate content of the makeup water. To the acid-treated, deaerated water, caustic soda, a non-gas-forming alkali, has to be added to restore feedwater alkalinity to where it can protect the afterheater system from acidic activity and also satisfy the boiler-water alkalinity demands.

**Softener Operation.** Running sodium-zeolite softener is fairly simple. It requires neither elaborate testing of effluent nor the close control demanded by other more intricate softening methods. It is, furthermore, the least expensive when not misapplied. But, as pointed out, this softening process works best with a clear, moderate-sodium, iron-free, near-neutral, low-alkalinity water. Such raw-water characteristics are not at all uncommon for they typify most city supplies and are naturally possessed by many springs. Even when additional correction is needed the easy operation of the sodium-zeolite method often overshadows the savings that can be realized with other methods.

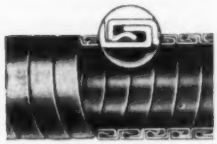
**2. HYDROGEN ZEOLITE.** In the hydrogen-zeolite procedure the hydrogen of the softening medium replaces not only calcium and magnesium hardness constitutents but also the sodium of the makeup water. The raw water's natural salts are thereby transformed into their corresponding acids, while the softener bed becomes converted to the calcium, magnesium and sodium-zeolite forms, Fig. 6. Upon regenerating the bed with sulfuric acid the absorbed calcium, magnesium and sodium elements are displaced. The zeolite is simultaneously replenished with the hydrogen ions needed to carry on further exchange

# Keep these *Dangerous* stresses *out of piping and equipment*



*CMH Corrugated Flexible Metal Hose can be furnished in steel, bronze, stainless steel and other alloys. Depending on size, type and material, pressures up to 12,000 psi (burst) and temperatures up to 1600° F. can be handled.*



*CMH Convoluted Metal Hose is made in a variety of types and in steel, bronze and alloys. Depending on size, type and material, pressures up to 500 psi and temperatures up to 600° F. can be handled.*

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MOTION or misalignment in rigid piping presents serious problems to the plant engineer. Piping subject to these stresses is in a potentially dangerous condition. In most cases these problems can be economically, dependably and safely solved by using CMH Flexible Metal Hose.

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has rectangular, square-edge steel bars that provide a non-slipping, level walking surface . . . 90% open area for light and ventilation . . . great strength to support heavy loading, without any lateral deflection of bars . . . no bolts, rivets or angle irons to loosen, or to collect dirt and refuse . . . no welds, with residual stresses that lead to warping.

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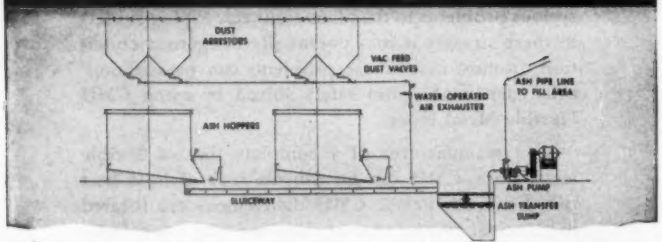


A Beaumont HYDRAULIC System: is particularly suited for high capacity ash-handling; handles wet ash or dry, molten slag and large clinkers; fits any type of power plant arrangement; is completely enclosed, preventing dust or gas from escaping to the boiler room; and can be operated by one man on a part time basis.

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DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS


## WATER SOFTENERS

*Continued from page 212*

reactions with the raw water, Fig. 7.

This cation process is thus capable of furnishing a softened water free of any alkalinity. Such a method can correct for excessive alkalinity concentrations in boiler water and the attendant high rate of blowdown. It also removes a possible serious corrosion condition for the return system. But it requires expensive acid-resisting materials throughout the softening stage, and very attentive control for efficient operation.

A less complete, but likewise effective, application involves coupling sodium zeolite with hydrogen zeolite. The proportion of raw water supplied to each of the two softener units in parallel is manipulated to yield steadily a feedwater with the desired alkalinity content. A similar effect can be achieved by employing pre-calculated ratios of sodium chloride and sulfuric acid in the dual regeneration of a single cation-zeolite bed. But this involves a most difficult control. In either case, justification of a hydrogen-zeolite softening method depends primarily on the relation of its costs to the solution it offers.

**3. DEMINERALIZATION.** Demineralization is a zeolite method by which practically all the raw water's dissolved solids are extracted. It gives a makeup water comparable to distilled water and, as such, is desirable for high operating pressure plants. By placing cation and anion exchangers in series, the makeup water is softened by hydrogen zeolite in the cation exchanger, and the acid radicals are then absorbed in an anion zeolite exchange bed which follows. Result is a water containing only hydrogen and hydroxyl ions, which unite to form additional water, Fig. 8 and 9.

In practice, a water so treated is never rendered absolutely pure. Regenerating the anion bed with caustic soda rather than with the cheaper soda ash gives a closer approach. The stronger hydroxyl ion provided by caustic soda proves more effective in removing objectionable soluble silica from the makeup water. Nevertheless, the fluoride of sodium, ammonium or calcium usually has to be added to transform the silica into fluosilicic acid, which the anion zeolite medium can absorb more easily. Moreover, using caustic soda eliminates the need to aerate the treated water, an intermediate step for enforcing the decomposition of carbonic acid that results from employing soda ash.

This involved scheme requires an exacting control and incurs a sizable initial expenditure, making its application justifiable only under the most urgent circumstances.

*Later articles will discuss lime-soda softeners and combination methods.*

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Accuracy is initiated at the BS&B Climax Controls division, where every control and valve must undergo rigid tests before delivery; and where engineers, metallurgists and laboratory technicians are constantly exploring and developing new materials, new methods, new and improved products, and new ideas.

In the Oil, Gas, Chemical and Petro-Chemical Industries, especially, the name "Climax" has become synonymous with efficiency and trouble-free performance.

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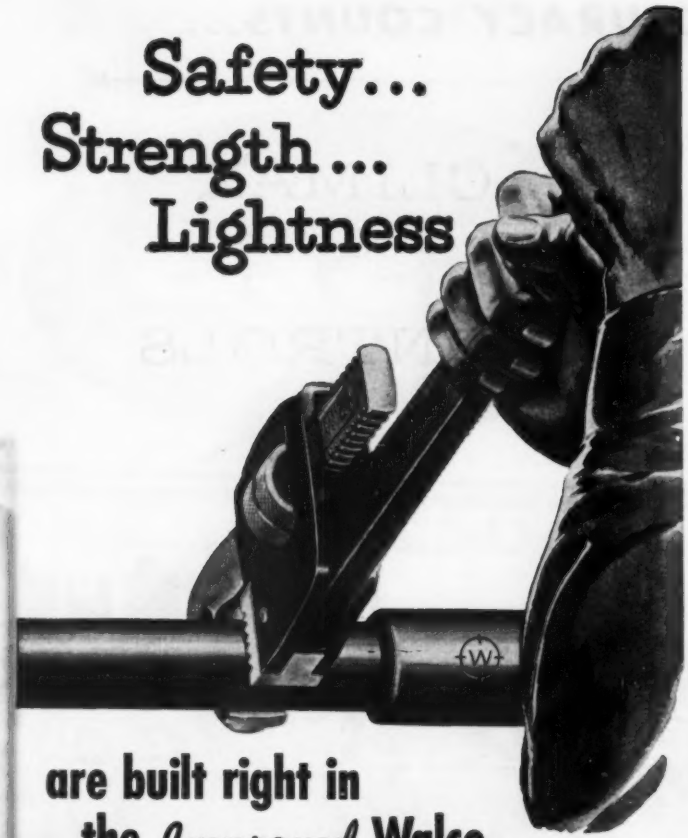

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Walco, the strongest pipe wrench on the market today, is also the safest – and lightest all-steel wrench available. Why? Because welding – with all its inherent strength, safety and weight-reduction advantages – has been used to join the Improved Walco's housing and handle into one integral unit . . . a unit that makes the Walco so rugged that all tests show it far exceeds the requirements set up by Federal Specification GGG-651a for Type II Heavy Duty Adjustable Pipe Wrenches.

The jaws of the Improved Walco are carefully machined and will not slip; even severe abuse will not spoil the wrench's grip or quick biting action. A flexible, double-acting, quickly replaceable spring – an Improved Walco feature for which patent is pending – gives the wrench fast, positive ratcheting action. Adjustment is easy – the nut may be spun with the palm of the hand. The proper wrench opening can be determined by a calibrated pipe scale on the movable jaw.

Ask your Walworth Distributor to show you the Improved Walco – the strongest-made and longest-lived pipe wrench on the market today. Buy it – you will save money in the long run.

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## MARMADUKE

*Continued from page 150*

Same damn thing that's being pulled by so-called "smart" business men today. Instead of getting the best power-plant help and paying top wages, they kid themselves by getting the worst and paying peanuts. So they shell out ten times as much dough for repairs and inefficiency, while the knuckleheads wreck the machinery.

"Wages were so low that no one did anything but gripe. Only Sleepy, the engine-room cat, was happy. And that was because plates of meat were all over the dirty engine- and boiler-room floors.

"First, I tackled the pumps. Then I put most of the other small auxiliaries in shape. With that off my mind, I tore into one of the Chuse engines.

"The manager was a good Joe in spite of the narrow-minded owners. He was tickled silly about my improvements. He said he'd be mighty pleased to see those engines run. Then he shook his head slowly.

" 'You might know your stuff, Mr Surfaceblow, but I'm afraid you won't get them to run.'

" 'How come?' I asked. 'I've yet to see a steam engine I can't get to perk.'

" 'Well,' he replied, 'various engineers tackled them since I'm here and they all threw in the sponge. But go ahead and try. If I can stop buying power, it'll be a feather in my cap.'

" 'What's the story on these engines?' I asked the day fireman, who had been there for years.

" 'Those engines are hexed,' he hinted darkly, shaking his head. 'They'll never run—never.'

" 'Bilgewater,' I said, and started tearing one of them apart. I ground the shoulders out of her cylinder, put in new piston rings, reset her valves, keyed up on her bearings, checked her governor and put her in pretty good shape after a few weeks.

"Just to make sure there was no slip-up, I checked her twelve-inch exhaust line in the concrete-floor trench. I struck gold! There was a blank flange in back of the exhaust valve. Looked like she had been there for years. 'That's your hex,' I told the maintenance man, as he removed it.

"Next morning there was plenty of excitement in the engine room. Word spread around the hotel that I'd 'try' to start the engine. All the skeptical older employes and many new ones were on hand. They crowded the hall outside the wire-meshed engine-room door.

"The manager came inside. He stuck out his hand, 'Good luck, Chief,' he said dramatically, as I stepped up to the throttle. You'd think I was Darius

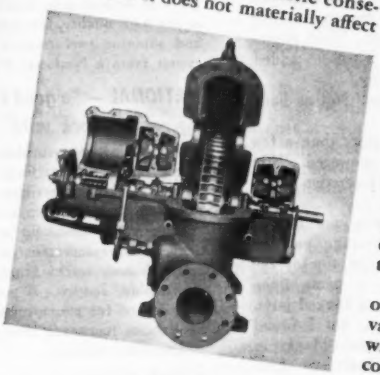
# TERRY

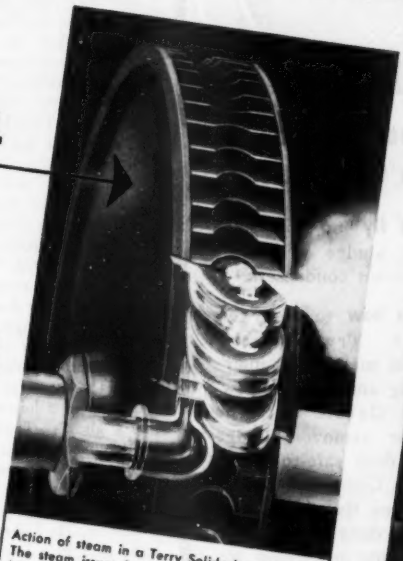
## THIS TURBINE WHEEL

### has no parts to loosen or work out

The rotor of the Terry Solid-wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Hence, wear of the blades is of little consequence, as it does not materially affect horsepower or efficiency. There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to shaft.





Action of steam in a Terry Solid-wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

This is only a small part of the story of the many advantages of the Terry Solid-wheel Turbine. Write for complete details.

**THE TERRY STEAM TURBINE CO.**

TERRY SQUARE, HARTFORD 1, CONN.

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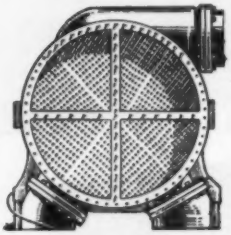
*Memo*

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

## You save steam



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## MARMADUKE

*Continued from page 216*

Green taking off in his flying machine. A hush fell on the audience as I grabbed her throttle valve. I could hear an old darky whisper, 'Dat engine won't run—he only kidding hisself.'

"Well, this was it. I'd give them a surprise they'd never forget. That engine was good as new and she'd run until I shut her down.

"I cracked her throttle and Chusie purred like a kitten. She rolled quietly, spitting condensate and steam from her drains. I could see bulged eyes through the screen. Then I closed her drains and gave her the gun. Talk about a sweet-running engine.

"The boys and girls whooped and hollered. They bust out laughing and slapped each other on the back. The manager grabbed my hand excitedly and pumped it hard, 'Nice work, Chief, I knew . . .' and then it happened. Chusie started slowing down, slower—slower—and then she stopped.

"'I tole you so,' shouted the old darky through the screen. 'I tole you so.' The manager picked up his heels and left in a hurry. His face was pale as a ghost's. Then the boys and girls left quietly, whispering to one another.

"I went back to my office, plopped down in my chair and started racking my brains. So just then the old fireman came in. He looked at me mysteriously and said in a low voice. 'That engine is still hexed, Chief.' Then he added, 'But not as bad as before.'

"That gave me a clue. Not as bad? 'How come?' I asked.

"'She never turned more than a few revolutions before,' he answered. 'Now she ran longer.' That information solved my problem.

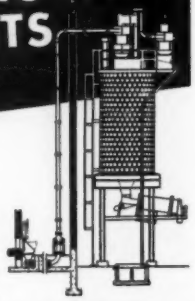
"I got back to Chusie, put on my coveralls and started tracing out her exhaust line. Way up on top of the hot-water heater tank, I came upon another suspicious-looking flanged joint. It was in a sealed spot, but I found another quarter-inch steel blank in her. The maintenance man was dumfounded. Years before, the engineer who laid up those engines evidently didn't have much faith in valves.

"With that blank out, Chusie hummed with delight. At long last, the 'hex' was lifted. Before long, we made our own juice, our own ice and had a top-notch plant again.

"But those blanks nailed down a lesson I had learned years before. NEVER BELIEVE ONE HUNDRED PERCENT IN AN OPEN VALVE."

*Next month: Marmaduke unfouls a plant that was knocked out by fuel oil.*


ADD TO YOUR **PROFITS** BY REDUCING **ASH REMOVAL COSTS**



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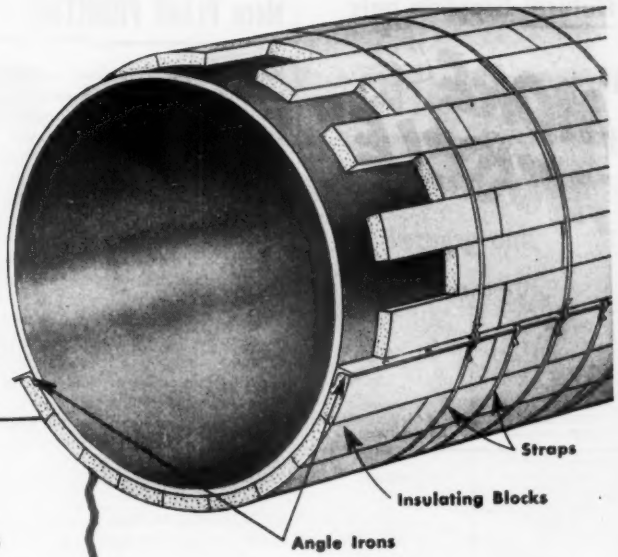
# We have been asked . . .

"What's the best way to prevent insulation on the bottoms of large tanks from sagging?"




"We plan to insulate a large, cylindrical heated storage tank," writes a company power engineer. "We have had trouble with insulation sagging on the bottom of similar vessels. What method do you recommend for applying insulation so that we can avoid this trouble on the new installation?" Here is our reply:

While there are a number of ways for applying heat insulation to this type of equipment, many of them often prove unsatisfactory. The expansion and contraction of the heated vessel causes the wires, cables, or bands to expand. When this happens, the insulating material becomes loose, starts to sag, and pulls away from the bottom of the tank. One method of application—that of attaching blocks to wires and then holding them in place by cables directly around the metal tank surface—seems to allow more sagging than other methods. Even the use of bands on the outside of the blocks will not prevent sagging if expansion and contraction is appreciable and the vessel being insulated is large.

The best solution to this problem is illustrated above. Here, the insulation on the bottom third of the tank is held in place by bands which are firmly anchored to welded-on angle irons. These bands should be spaced about 6" apart to provide adequate support. The short distance from angle to angle greatly reduces the stretching that would occur if the bands completely encircled the tank. Helping you find the answer to any insulation problem is only a part of Armstrong's service.

We can take over the entire job for you—furnish top-quality materials plus skilled technicians to apply them—and eliminate the costly failures that often result from lack of knowledge or poor workmanship. Next time you're up against any kind of insulation problem, call your near-by Armstrong representative. Ask him about Armstrong's *complete* insulation service that insures you a thoroughly professional job.

**SEND US YOUR QUESTIONS.** If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write us. We'll do our best to send you a prompt and practical answer. Just outline your problem on a post card or letter and address it to Armstrong Cork Company, 7011 Maple Street, Lancaster, Pennsylvania.

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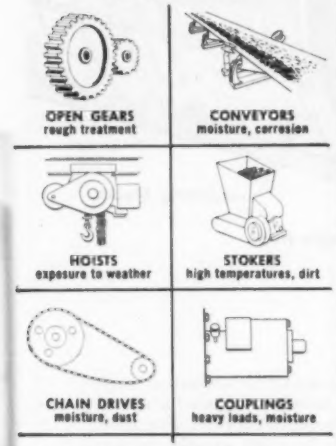


*In Fact:*—for *all* applications where conditions of dirt, dust or moisture prevail.

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Dixon *Natural* Graphite is practically indestructible. It withstands extremes of heat and cold. It is insoluble. Inert, it is unaffected by acids and alkalies. Processed under closest laboratory control.

***What is your toughest lubricating problem?*** Tell us the full particulars . . . our technical department will analyze your problem and send you specific recommendations and a sample of the proper Dixon lubricant. No obligation. Write, Joseph Dixon Crucible Co., Jersey City 3, N. J.

# DIXON

## NATURAL GRAPHITE


# More PLANT PROBLEMS

Begins on page 138

**VALVES STICK.** Shut down engine and take out inlet valves and stem guides. Late closing *NS* reports indicates valves are badly gummed and sticking. If valves and seats aren't burnt, warped or worn out, clean with a good gum solvent. Grind in to a tight fit after cleaning. When inlet valves seat tightly hot combustion gas can't heat valve parts. Tappet clearance stays about the same so valves operate at or close to builder's timing.

Check engine compression and spray nozzles. See that fuel oil recommended by builder is used. Fuel containing too much asphalt and heavy ends can cause valve and ring trouble. Horsepower of *NS's* engine seems close to what it should be, when figured with standard formulas.

ARTHUR BELTON *Montreal, Can.*

**USE BUILDER'S TIMING.** It is well within usual diesel timing specifications. With present timing the engine is losing a considerable amount of air at the start of compression.

To find point of fuel injection, try this method: With engine at rest, pipe 100-psi air to injectors and block off fuel. Open indicator cocks on cylinders. Then bar engine over slowly, listening at one of the indicator cocks. Air will be heard entering cylinder at time of fuel admission. If all other conditions are correct, this will give crank position at time of fuel injection. *Note:* This method can be used only when it is possible to pipe air to the fuel injectors.

HAROLD E ALENKA *Brownsville, Tex.*

**USE INSTRUMENTS.** *NS* can find best valve setting by using an indicator, pyrometer and compression gage. In general, inlet valve should be set so it is open during start of compression. This permits increase of cylinder charge because incoming air has enough momentum to overcome slight rise in pressure at start of compression. Exact timing depends on engine speed and operating conditions.

S M BAILEY *Downey, Ill.*

---

**Nordberg Mfg Co** has been granted a world-wide exclusive license on the Miller Supercharging System for 4-cycle engines over 8½ in., and 2-cycle engines over 13½-in. piston diameters. Nordberg has the right but are not obligated to sublicense manufacturers to build engines limited by the above sizes. The company also retains a nonexclusive license to build 2- and 4-cycle engines in cylinder diameters below 13½ and 8½ in., respectively. In this range of sizes the patentee, Ralph Miller, retains the right to grant nonexclusive licenses.


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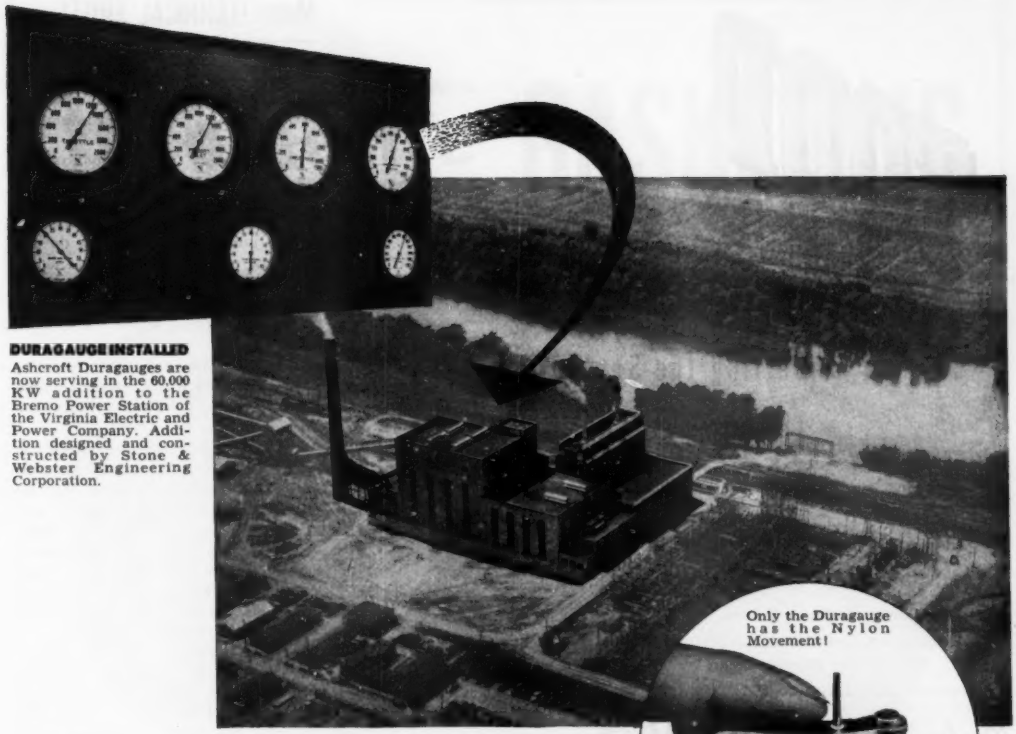

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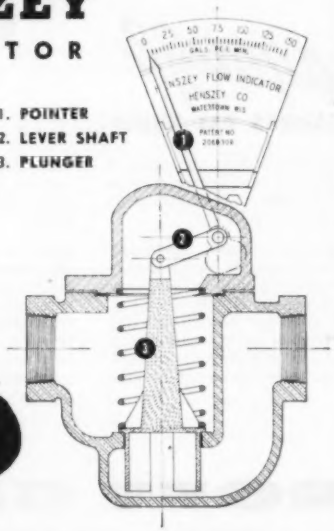


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## More TECHNICAL BRIEFS

Begins on page 158

the superheater means less required superheater surface than normally used for installations firing more conventional coals.

Boiler outages are not too frequent for cleaning purposes. Conventional sootblowers in the boiler passes and occasionally furnace-wall blowers will do the job. Slag formation in the furnace and on the slag screens is mostly of a spongy nature, which drops off during light-load period, or can be removed by lancing. *ASME paper No. 51-F-18.*

**Basic Design Elements and Operating Experience With North Dakota Lignites.** *By L Pistner, Fuel Economy Engineering Co.*

Summarizes an experience with installations using North Dakota lignite without pre-preparation. It starts with the initial work in 1926 and terminates with work substantially concluded in 1951. Certain of the commonly held conceptions relating to methods of using a high-moisture low-Btu fuel are analyzed and in part refuted. In addition, a summary of basic conclusions is submitted.

As an example of some of the author's conclusions, it may be noted that the "anthracite type" installation commonly used for burning anthracite did not prove well suited to handling North Dakota lignite. Further, the use of a so-called open-type furnace design for burning Illinois coal resulted in rather extensive modification wherever used.

The need for maintaining arches arises not so much from improved ignition effect of the hot surface, as with anthracite, but rather from need to use these surfaces for effective mixing of rich gases from the front end of furnace with lean gases from the rear end. Use of overfire air jets instead of the deflecting arch surfaces has proved, in many instances, unsatisfactory. Where over-fire air does help, however, is in its role of reducing stratification and in adding needed preheated air for shortening the flame length. *ASME paper No. 51-F-20.*

*Directions for ordering papers on p 160*

**Storage of Coal.** *By W L Lundy, Kimberly-Clark Corp.*

Storing coal during the off-peak mining period, with the lower transportation cost in some localities, makes a large coal-storage pile advantageous both for economy and for operation. The author discusses various methods of storing coal and treatment of the pile surface to reduce losses from coal-storage fires,

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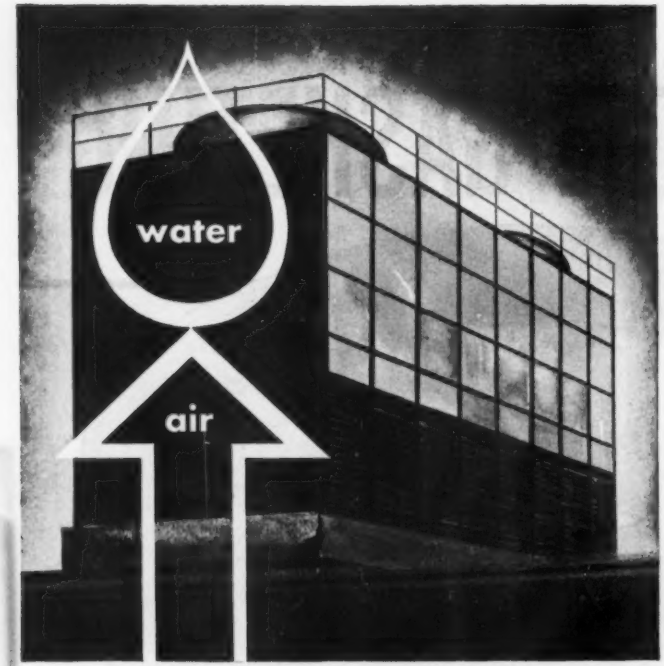


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# More TECHNICAL BRIEFS

Begins on page 158

wind and weather. A résumé of rules is included.

Fundamentally there are four known substances that contribute most to firing coal in a storage pile. This firing is known as spontaneous combustion. Three of the substances causing it are iron pyrites, water and oxygen. The author discusses how they combine and act as a pilot to start reactions leading to a loss of heating values in coal in storage. Under accelerated conditions visible burning can take place.

A number of pointers are advanced on (1) conditions for good storage (2) some of the properties of coal that lead to handling problems (3) methods of coal piling, sealing and capping. *ASME paper No. 51-F-25.*

## Instruments

**Design Studies for a Very Fast Electrostatic Relay.** *By Eugene W Pike, Raytheon Co.*

Detailed theoretical studies indicate an electrostatically operated relay could offer many advantages for certain types of service over conventional magnetic relays.

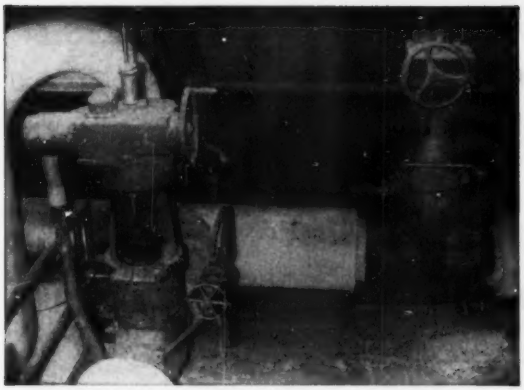
Principal advantages expected would be (1) operating time as short as 50 microseconds (2) small size and light weight (about equal to a sub-miniature tube) (3) operation on dc or ac of any frequency up to about 1000 mc (4) extremely rugged with all relevant natural frequencies above 10 kc (5) negligible power consumption (6) low-cost and simple construction.

Primary disadvantage is said to be the low power-handling ability of the contact. Details of the design analysis are given. *NEC paper, no number.*

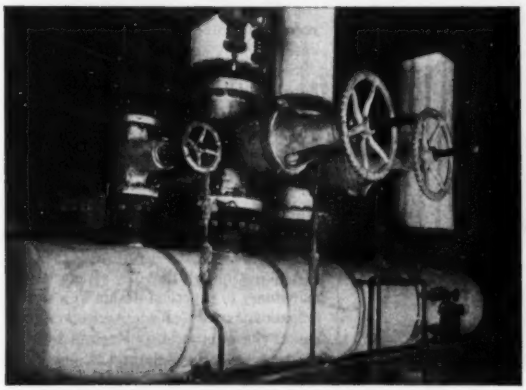
Directions for ordering papers on p 160

**Performance of High-Pressure Instruments.** *By C E Balcerzak and J A Skillern, Synthetic Fuels Demonstration Plant, Bureau of Mines.*

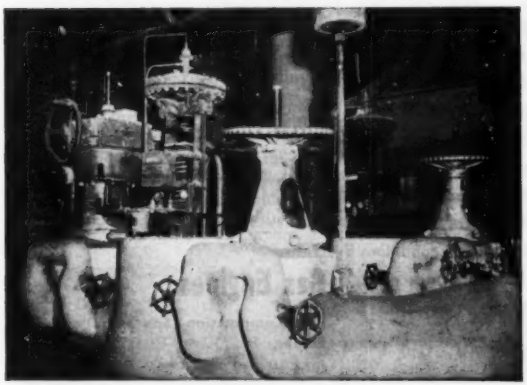
Bureau of Mines Coal Hydrogenation demonstration plant at Louisiana, Mo., has made one vapor-phase and five liquid-phase runs during the past year. This operating experience has developed information on the effects of vapor pressures, viscosity, gas densities and other factors, and measurements and controls of process variables at high pressures. System pressures are measured either by locally mounted Bourdon-type gages or by indicating pneumatic transmitters. Elements for measurement of controlled pressures were designed for 20,000-psi service. Elements for the indicating-



Walworth Motor Operated Series 900 Pressure-Seal Cast Steel Gate Valves.



Walworth Series 600 Pressure-Seal Cast Steel Gate Valves.



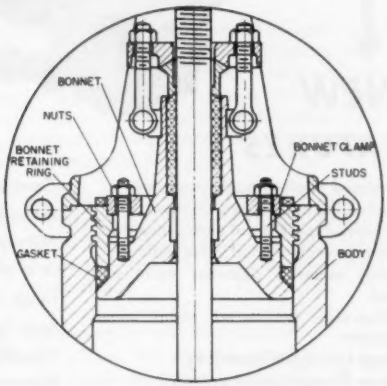
Manually operated and motor operated Walworth Series 900 Pressure-Seal Cast Steel Gate Valves.

# WALWORTH PRESSURE-SEAL CAST STEEL VALVES

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved disc design provides flexibility, and helps keep seats tight, even when the valve body may be distorted by pipeline stresses, or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, and 1500 and in a wide range of sizes and types. For further information, see your nearest Walworth Distributor, or write: Walworth Company, 60 East 42nd Street, New York 17, N. Y.

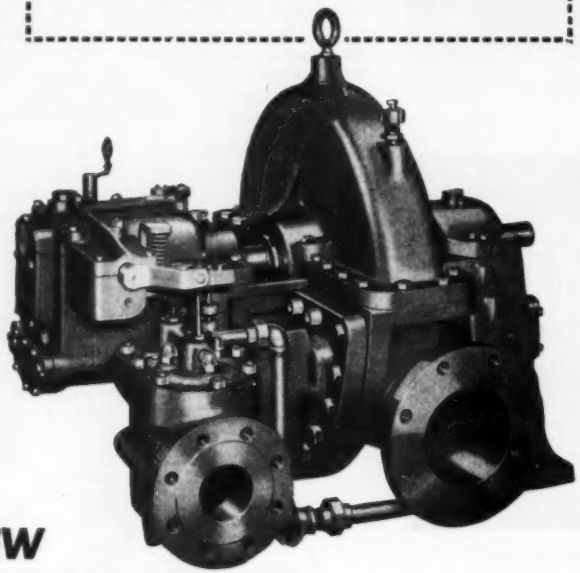



A cross section of the bonnet joint assembly of a Walworth Pressure-Seal Cast Steel Gate Valve. The internal pressure is utilized to make the body-to-bonnet joint tight.

**WALWORTH**
**valves and fittings**
**60 EAST 42nd STREET, NEW YORK 17, N. Y.**

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

# NEW!
# MURRAY
## TYPE H
## MECHANICAL DRIVE SINGLE STAGE STEAM TURBINE



NEW

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- Enclosed 'shaft-through' governor
- Fast acting hand speed changer
- Improved spark proof emergency stop
- New convenient hand valve position
- Easily removed governor valve and seat
- Removable perforated metal steam strainer
- Large bearing oil reservoirs
- Large finned-tube oil coolers
- Magnetic oil-drain plugs
- New type split oil rings
- Corrosion resistant carbon packing cases
- Chrome plated shaft under carbon rings

Combining a host of new improvements plus time tested features, the Murray Type H offers extra-value in a medium size machine. With a range of 50-200 H.P., depending upon speed and steam conditions, it is offered with either a 16 or 20" diameter wheel. 3" or 4" steam inlet sizes available. Steam conditions up to 600#, 750° and back pressures up to 150# can be used.

*Write today for full details.*

**MURRAY IRON WORKS COMPANY**
**BURLINGTON, IOWA**

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY


## More TECHNICAL BRIEFS

Begins on page 158

pressure transmitters to recorders and for nonindicating controls were designed for 15,000-psi usage. Four of the 15,000-psi elements and three of the 20,000-psi tubes failed at 10,000 psi after short service. These elements were fabricated from AISI-431 steel. Their short life contrasted sharply with elements fabricated from AISI-316 stainless steel, which now has a performance record above 100 days at the same operating pressure.

At first some problems developed in mounting pressure transmitters. If rigidly anchored in the vicinity of the case using carefully fitted tubing, the stress was considerably reduced on the measuring element. Mounting of pressure gages was more easily handled. The coupling of the socket connection was rigidly anchored and supported the gage case.

Similar observations on temperature flow, liquid level and other measuring devices are covered. *ASME paper No. 51-PET-7.*

*Directions for ordering papers on p 160*

**Static Magnetic Exciter for Synchronous Alternators.** *By H F Storm, General Electric Co.*

Application of the use of electrical machinery to practical design of a static magnetic exciter. Basic exciter circuit makes the alternator (energized by the exciter) as self-regulating as possible. Any remaining deviation of alternator voltage affects a voltage-sensitive circuit to supply a correction signal to exciter. The exciter draws all its energy from the alternator.

Under this system no beams are needed for antihunt. Further the steady-state alternator voltage can be held within + or − 0.6%. Transient response is rendered and yet well damped. A short circuit of the alternator will not cause loss of excitation and it is said that during a short circuit the excitation becomes several times normal. This is highly desirable for selective tripping of protective devices. *AIEE paper 51-196.*

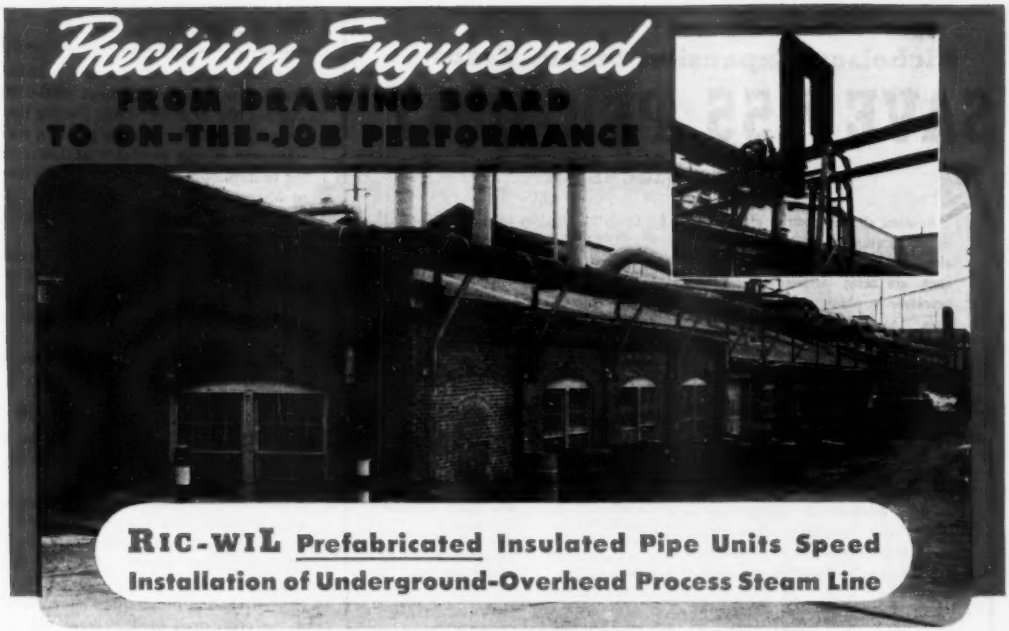
## Gas Engines

**High-Compression Spark-Ignition Gas Engine.** *By George Stevens, Worthington Pump & Machinery Corp.*

The author begins by reminiscing about the early developments of the gas engine. As a result of early findings the industry had been content to carry on with low-compression spark-ignition gas engines (somewhere under 120 psi

# Precision Engineered

**FROM DRAWING BOARD TO ON-THE-JOB PERFORMANCE**



## RIC-WIL Prefabricated Insulated Pipe Units Speed Installation of Underground-Overhead Process Steam Line

A PROCESS STEAM LINE recently installed at a large adhesives manufacturing plant demonstrates many of the outstanding advantages of Ric-wiL *Prefabricated* Insulated Piping Systems.

Process steam leaving the boiler head at 145 psi is delivered to the adhesives mixers—a key operation—by a line constructed of Ric-wiL Hel-cor Pipe Units carrying an 8" steam pipe and 3" condensate return. Both pipes are insulated and housed in the same conduit, which runs underground beneath two railroad tracks and a concrete roadway as well as overhead between and alongside various plant buildings.

All units, accessories and sub-assemblies were accurately prefabricated at the Ric-wiL factory to individual specifications of this installation. With the complete system and all details laid out on the drawing board, pipes were cut to precise lengths required and each component unit was precision prefabricated. Each unit was identified for its exact position in the system, ready for single handling installation upon delivery, with a minimum of field work and time required.

The inherent flexibility of Ric-wiL Insulated Pipe Units makes it possible to provide adequate compensation for stresses and reactions caused by expansion, using a minimum of expansion devices. Only one expansion loop was required for this installation since a substantial portion of the expansion was absorbed in directional changes of the line.

Precision prefabrication, protection and insulation by Ric-wiL time-proved methods assure piping systems of high thermal efficiency, corrosion resistance, durability and strength, coupled with speedy, low-cost installation.

★ **Ric-wiL Prefabricated Insulated Piping Systems are made-to-order for distribution piping of process liquids, viscous fluids, oil, refrigerants, steam, hot or cold water. Ric-wiL engineers will be glad to consult with you on your insulated piping problems —without charge or obligation. For full information write The Ric-wiL Co., Dept. 50X.** ★

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INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

## Nicholson Expansion Steam Traps

# SAVE $155 PER UNIT

### for Large Processor

Because of their positive effectiveness in temperature control work, Nicholson expansion steam traps, at about $35 each, are being installed by a leading processor in place of temperature controls. These were costing them $110.00 to $200.00, with cost of a trap added. Per installation, the saving is about $155.00.

Easily adjusted to pass condensate at any temperature below 212°F.

Because there is only one moving part, remarkably low maintenance costs are being shown. Easily installed, usually without supports. Lengths, 9" to 40". Pressures, 0 to 250 lbs. No air binding.

This firm is finding an increasing number of applications on tanks, stills, heating radiators, etc., where Nicholson expansion steam traps are serving as both trap and temperature controller.

**For All Equipment Using Steam or Hot Water**

Radiators
Separators
Paper Machinery
Pipe Coils
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Dry Kilns
Vulcanizers
Switch Heaters
Laundries
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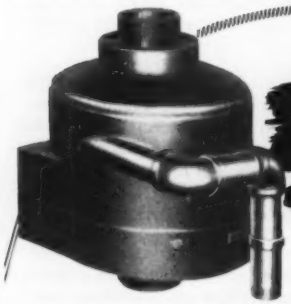
*Catalog 751 or see Sweet's*

**W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.**





**WILSON**
CENTRIFUGAL
BLOW-DOWN SEPARATORS

*Eliminate Blowdown Tanks*

Wilson Centrifugal Blow-Down Separators permit direct drainage of boiler blowdown to the sewer or other disposal at atmospheric pressure. Flash steam and pressure are relieved through a large vent without entrapped water or objectional noise.

Installation of separators can be made wherever convenient — at the boiler, on the boiler house roof, or outside the boiler house walls. Two models cover all boiler blowdown requirements from 10 to 4,000 B.H.P. In use, in lieu of blowdown tanks, in almost all states and many municipalities.

***Write for Bulletin 30, which gives complete details and simple installation diagrams.***

**WILSON** ENGINEERING CORPORATION

**122 South Michigan Avenue, Chicago 3, Illinois**


## More TECHNICAL BRIEFS

*Begins on page 158*

as a stop limit) into the early 1940s. Fuel consumption was about 9000-9500 Btu per bhp hr at full load. During that period advantages of using gas as a fuel whenever it was available at low cost led to development of a convertible unit to operate as an oil engine with full diesel compression and as a gas engine when gas was available.

From here on the author discusses the major advantages in the field of ignition and illustrates the paper by sample gas-timing valves, a cam contour guide ram showing gas entry timing and a number of curves on borderline knock performance, and knock-limit detonation. *ASME paper No. 51-PET-21.*

**Diesel Duafuel and Gas Engine Operating on Supercharged System.** *By Ralph Miller, Nordberg Co.*

Discusses the effect of compression ratio, pressure and temperature on engine output and efficiency. Mathematical expressions develop some of the more theoretical aspects and performance curves and illustrations show many of the company's models in actual installation.

Advantages of the Miller system of variable compression ratio supercharging are discussed. The gain in horsepower output and efficiency over the conventional type of engine is also included. Results are obtained without increasing heat flow to water jacket per unit time, which means internal surface temperatures for the maximum combustion pressures now established and accepted in conventional 2-cycle engines at full load ratings are still held. *ASME paper No. 51-PET-24.*

*Directions for ordering papers on p 160*

## More POWER NEWS

*Begins on page 156*

tel and vigorously oppose formation of such a cartel by others. But we should encourage world-wide interest in developing more efficient methods for producing crude rubber and increasing its usefulness.

"Competition between crude and man-made rubbers at home and abroad is a natural and desirable consequence of private ownership of synthetic rubber producing facilities. This competition will benefit not only rubber consumers the world over, but also rubber producers."

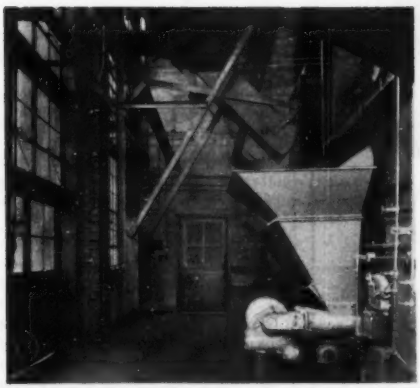
### Chemicals Vie For Oil Shale

There is a huge reserve of potential

FAIRFIELD SERVES THE NATION'S POWER PLANTS

# CUSTOM TAILORED

FOR EFFICIENT POWER HOUSE OPERATIONS



*1000 lb. hand operated weigh larry feeds into extension hoppers.*

Yes, as master tailors for thousands of coal and ash handling systems around the country, Fairfield will engineer your system to fit the needs of your power house. For example, take the installation pictured here. Coal, unloaded from the car via a track hopper, passes through flight feeder and bucket elevator into a 280 ton tile storage silo. Weigh larries in conjunction with extension hoppers feed boilers as required from storage. Ash is removed by buggy to bucket elevator which loads it into a 20 ton silo, for removal by truck. A typical, complete, smooth functioning system made possible by Fairfield engineering, construction and erection.

You, too, can be sure of proper design, construction and operation of the system for your expanded or new power house facilities . . . by reviewing your needs today with an experienced "power house" man, the Fairfield Sales Engineer. Write for your copy of Bulletin 650.

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Die-Cast
BEARING
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A DEPENDABLE SOURCE OF SUPPLY—
Your Magnolia Distributor
Look to your Magnolia Distributor for a dependable localized source of service and supply for all your bronze bearing metal requirements. Backed by Magnolia's years of experience and research, your Magnolia Distributor can be a big help during these difficult days of shortages and high production requirements.
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SOLD THROUGH INDUSTRIAL DISTRIBUTORS EVERYWHERE
MAGNOLIA METAL COMPANY
21 West Jersey Street • Elizabeth, New Jersey


## More POWER NEWS

Begins on page 156

strategic chemicals, solvents, waxes, asphalts and tars in the great oil-shale deposits that cover 16,500 square miles of Colorado, Utah and Wyoming.

In some instances, according to J H East Jr, regional director of the U.S. Bureau of Mines at Laramie, Wyo., oil shale is a better source of chemicals and byproducts than petroleum.

Benzene is a prime example. Last year the U.S. used approximately 190 million gal of benzene, largely for synthetic rubber. Smaller quantities went into synthetic phenol for plastics, aniline for dyes, nylon, DDT, aviation gasoline, detergents, solvents, etc. Synthetic liquid fuel plants can produce benzene from either oil shale or coal.

An oil-shale plant operated to recover benzene would also produce a large amount of ethylene, which is used for ethyl alcohol, ethylene glycol (an antifreeze), synthetic rubber, plastics, insecticides, dyestuffs, aviation fuel, antiknock fluids, explosives, refrigerants, resins, toilet creams and anesthetics.

At the Petroleum and Oil Shale Experiment Station in Laramie, a high-speed, high-temperature retorting process is under development. It offers an attractive way to use the 5 to 10% of extra-fine crushed shale that has formerly been discarded as waste.

In conjunction with a normal retorting plant, the new process would yield a crude oil containing about 40% high aromatic gasoline with an octane rating of 100. This could upgrade the gasoline from the normal retorting part of the plant.

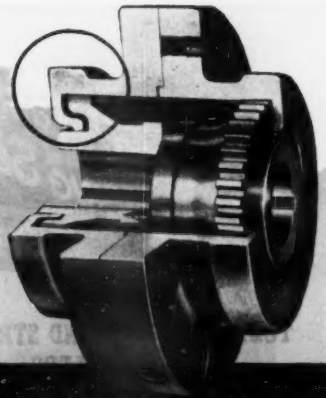
"However," according to H M Thorne, Chief of the Oil-Shale Research Bureau, "considering the present critical need for aromatic and other chemicals and their high market value, it seems more desirable to recover and purify the individual chemicals from the high temperature retorted oil and gases."

Based on the small pilot-plant experiments, a plant retorting 20,000 tons of average (30 gal per ton) oil shale daily would produce annually 12 million gal of nitration-grade benzene; 2 million gal of motor-grade benzene; 6 million gal of toluene; 2 million gal of xylenes; 2.4 million gal of solvent naphtha; 0.7 million gal of crude tar acids; 39 million gal of ethyl alcohol; 2 million gal of solvent-grade ethyl ether; and 29 million lb of naphthalene.

A commercial plant to produce this volume of products would cost about $55 million, including the mine, retorts, purification and other auxiliary facilities, according to estimates made at Laramie, Wyo. installation.

*For APPOINTMENTS, turn page.*

# NEED "SPECIAL" COUPLINGS?



## Koppers Can Help You Save Money With *Easily Modified*

# STANDARD Fast's Couplings

**FOOLPROOF DESIGN:** Instead of perishable oil seals, Fast's use a permanent metal-to-metal closure. Oil is always maintained at a safe level, whether the Fast's is running or standing still!

**LOWEST COST:** Fast's Couplings cost less per year because they normally outlast the equipment they connect. Original cost can be divided by 20 years or more. As one user says: *"We've had this Fast's Coupling since 1930 . . . it's apparently going to last forever!"* (Name on request.)

**NEW DEVELOPMENTS:** Fast's were the first gear-type couplings on the market. And they're first again with new designs developed by Koppers —like the revolutionary new Breaking Pin Coupling now available.

IF YOUR coupling problem looks tough—specify Fast's. Then Koppers' engineers can go to work, study your problem, and in many cases find a special coupling is not needed at all. Instead, these coupling specialists can often modify a *standard* Fast's Coupling and save you important money!

Standard Fast's Couplings can be modified for hundreds of unusual applications. Records kept over the past 31 years prove that Fast's Couplings outlast the equipment they connect. Fast's still maintains its original design, without basic change or sacrifice in size or materials.

Don't take chances. Whether your application calls for special or standard couplings, specify Fast's. For full information and specifications, write for your copy of Fast's free catalog today!

KOPPERS

**FAST'S**

THE ORIGINAL GEAR-TYPE

**Couplings**

INDUSTRY'S STANDARD FOR 31 YEARS

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**KOPPERS CO., INC.,** ***Fast's Coupling Dept.,***
**321 Scott St., Baltimore 3, Md.**

*Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.*

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COIL AND SPECIALTY BENDING
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ALLPAX
"The Packing that Packs All"
STYLE No. 14 outperforms
in oil refinery service.

There's an ALLPAX Packing for every specific purpose. Style No. 14, recommended for centrifugal pumps, valves and swing joints, is widely used in handling high octane aviation gasoline, light and heavy oils, greases, benzol, etc. It can be used on temperatures up to 700°F. Made in sizes from 3/16" to 1¼", this self-lubricating packing maintains its resiliency, stops leaks, eliminates friction and scoring and assures maximum efficiency and minimum attention.

Also:

Valve Discs; Sheet Packing; Retainer Packing; Molded and Mandrel Cut Packing Rings; Packing Hooks; Gasket Cutters.

Other Packings in the ALLPAX line are designed for such services as general utility, chemical, food, wood pulp, paper, etc.—a type for each specific service.

ALLPAX Packing quality is being maintained in spite of material shortages. Consult your nearest distributor. Ask for Catalog describing the complete ALLPAX line.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.


## APPOINTMENTS

**Dr Henry Townley Heald,** president of Illinois Institute of Technology in Chicago, has been elected chancellor of New York University. He will become head of the nation's largest university about Jan 1, succeeding Dr Harry Woodburn Chase, who retired in July.

In the Midwest, Dr Heald is well known as an educator, engineer, civic leader, business executive and administrator.

He was named president of Armour Institute of Technology in 1938 and became president of Illinois Tech in 1940 when Armour Institute and Lewis Institute combined. He is also president of Armour Research Foundation, and heads the Institute of Gas Technology in Chicago.

Dr Heald is a director of Research Corp of New York, American Steel Foundries, Peoples Gas Light and Coke Co, and Stewart Warner Corp. He is a structural and a professional engineer in Illinois; and past president of the American Society for Engineering Education, Western Society of Engineers and the Association of Urban Universities.

**Allis-Chalmers Mfg Co** announces election of vice presidents W G Scholl, in charge of sales for tractor div; C W Schweers, in charge of sales for gen mach div; J F Roberts, in charge of engineering for gen mach div; W A Yost, of gen mach div; and G F Langenohl, treasurer and asst secretary. R M Casper becomes mgr of new power dept combining former electrical and mechanical power depts; F W Bush is in charge of electrical sections; C C Jordan, in charge of mechanical sections; R N Miers, of steam turbine section. Tom W Metz becomes mgr of Indianapolis dist of gen mach div; and Robert F Loos of the Evansville dist.

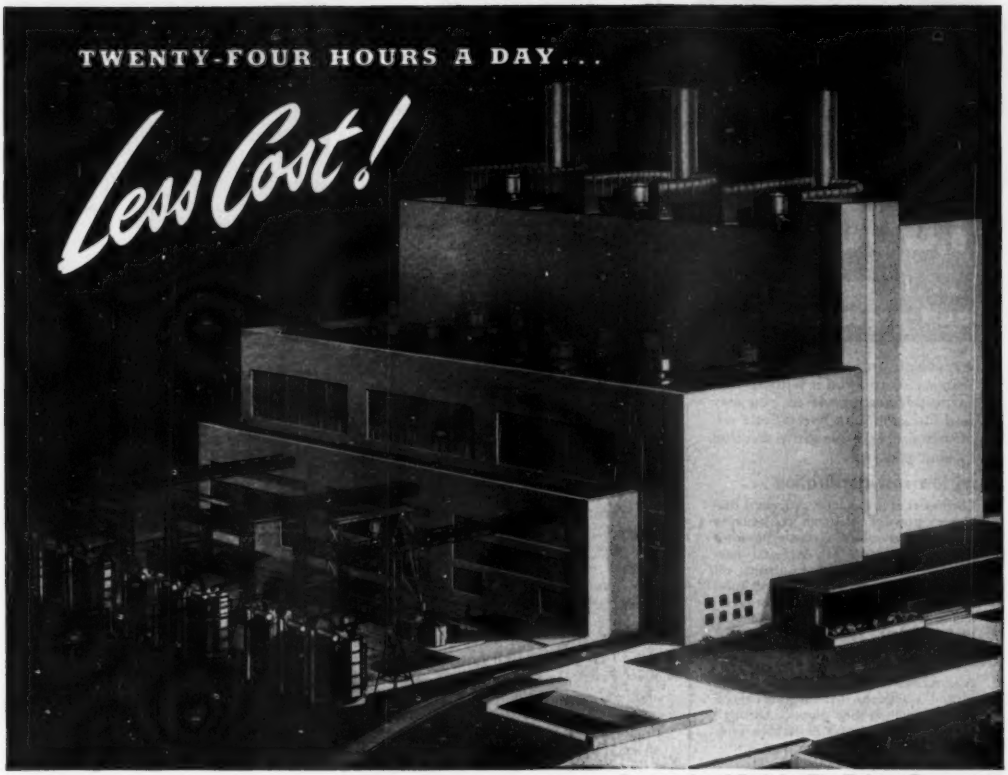
**Swartwout Co** announces opening of Texas sales office in Room 674, M & M Bldg, Houston. J B Downey manages the power plant and process control divisions, Wm A Sharp the roof ventilator sales.

C. J. Wirth becomes v-p and sales mgr of **Slater Electric & Mfg Co.**

**Worthington Pump and Mach Corp** executives in new posts are: George P Passmore, asst to vice president in charge of mfg at Harrison; A M Tullo, works mgr at Wellsville, N. Y.; assistants to works mgr at Harrison are John Burlick, in charge of industrial engineering and Max A Heyman, in charge of production control; W D Sizer, is mgr of regional engineering and service dept; George F Habach, is executive engineer at Harrison, and Everett Schmactenberg, chief engineer of centrifugal eng div. Sales vice president, Charles E Wilson retires, but has been appointed West Coast consultant on sales problems. H V Rasmussen becomes executive engineer at Wellsville.

**Taylor Forge and Pipe Works** appoints Gale Carrol to the Houston District sales office.

George T Humphrey Jr becomes asst gen mgr of service sales div, **Timken Roller Bearing Co.**




*Designed and Built by The Kuljian Corporation*

Electric power producers are under more constant pressure than almost any other industry.

They must be prepared to carry normal loads around the clock year after year and meet large unexpected demands at any hour. They must be sensitive to every industrial and commercial need.

Under such trying conditions, it is basic that efficient operating practice alone is not enough. Utmost economy and reliability must be *built into* each generating unit from the start.

For more than a score of years, Kuljian engineering and Kuljian construction methods have been building long life and money saving efficiency into power plants for both public utilities and large industrial plants.

WASHINGTON, D. C.
ROME, ITALY
CALCUTTA, INDIA
CARACAS, VENEZUELA

*The* **Kuljian** *Corporation*

**ENGINEERS • CONSTRUCTORS**

**1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.**

# How to reduce OIL CONTENT below 1/10 part per 1,000,000 ...in condensate and process waters

Are you discarding oil-contaminated water... or re-using it without adequate purification? If so, you may find filtration with Sorbo-Cel a relatively simple, inexpensive solution to your problem.

**Easy, low-cost clarification...**

Sorbo-Cel is a specially processed diatomite powder. Used in conjunction with any standard screen-type filter unit, it provides a fast, easy and inexpensive way to absorb emulsified oil and other impurities from water. Total processing costs (including both material and operation) are only from 1¢ to 3¢ *per 1000 gallons.*

**How Sorbo-Cel works...**

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through the filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through. Oil removal is virtually complete—less than 0.1 ppm remaining.

**Other important advantages...**

In addition to trapping out oil globules, Sorbo-Cel filtration removes suspended solids such as rust, scale, and clay. Boiler-tube life is increased, scale formation is reduced, and shutdowns are less frequent. In plants using graphite or wet-steam lubrication to keep condensate oil-free, this method permits a return to the more efficient oil lubrication—with resultant economies in ring wear.

For further information about Sorbo-Cel filtration, use the coupon below.

**Johns-Manville SORBO-CEL®**

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name _____
Company _____
Address _____
City _____ State _____
POW-1


# More APPOINTMENTS

Begins on page 232

Beaver Falls district sales office of **Babcock and Wilcox Tube Co** moves from the plant to 712 Eleventh St, Beaver Falls, Pa.

**Bowser, Inc,** purchases National Scientific Laboratories, Inc, of Washington, D. C. Dr Robert I Sarbacher remains as president of the Laboratories and becomes director of research for Bowser.

Thomas O Schrader is elected v-p of **Erie City Iron Works,** and continues in charge of sales.

**Elliott Co** appoints A P Wendland mgr of gen service dept, succeeding the late Frank Murphy.

**General Electric Co** announces formation of six new operating divisions and lists their gen mgrs as follows: turbine div at Schenectady, Glenn B Warren, gen mgr; motor and generator div, Schenectady, James M Crawford; transformer and allied products, Pittsfield, Francis E Fairman Jr; switchgear and control, Philadelphia, George E Burens; measurements and industrial products, Lynn, Mass., Harold E Strang; component products, Fort Wayne, Wm C Wichman.

Walter A Mattson becomes asst to gen mgr of GE's meter and instrument dept at West Lynn, Mass. Asst mgr of advertising and sales promotion of the apparatus marketing div is Ralston B Reid. J Herbert Behm is new staff asst to engineering mgr of small apparatus div at Lynn, and Donald F Warner becomes asst to mgr of engineering of the turbine dept. Willard V Merrihue headquarters in New York as mgr of new employe relations service dept. Asst mgr of manufacturing services div in Schenectady is Arthur F Vinson. John W Belanger becomes vice president of the company and gen mgr of newly created defense products div, and Nicholas M DuChemin becomes vice president heading mfg services div.

**Dearborn Chemical Co, Ltd,** announces appointment of Dr Wm A James as director of research at the Toronto laboratories, and Jerry Shaw as sales representative.

**E F Drew & Co** announces appointment of Robert H Bishop as v-p in charge of sales, succeeding George H Kent who becomes executive v-p.

Brown Instrument Div, **Minneapolis-Honeywell Regulator Co** names three new industrial mgrs—W J Blackburn, Denver; Donald D Baker, Kansas City; Jack F Smith, Tulsa.

**Midwest Piping and Supply Co, Inc,** appoints John E Brock director of research with headquarters at St. Louis, Mo.

**Iron Fireman Mfg Co** reopens its Southern regional office at 607 Haas-Howell Bldg, Atlanta, Ga. E V Crossin, mgr, Hugh Smith, field engineer, and J H Merritt, Jr, industrial sales mgr, have headquarters

# Cure for a Dirty Shakedown

Twice each day it was necessary for a large Eastern steel producer* to shakedown his furnaces. This caused high concentrations of dirt which resulted in severe air filter maintenance and inefficient air conditioning.

FARR Company, when called upon for a permanent solution, recommended a FAR-AIR** Self-Washing Filter. This proposal was followed and an installation made. After two years of use, the results are very satisfactory and another FAR-AIR unit has been installed in the same plant.

The unit was set to automatically wash and re-oil itself just prior to the time that the furnaces were shaken down. Thus, maintenance was virtually eliminated and the filters were always at peak efficiency.

FAR-AIR Self-Washing Filters can be furnished to handle any CFM requirement. If you have a special air filtration problem, Farr engineers will help you find the proper solution. Write for complete information to Farr Company, P.O. Box 10187 Airport Station, Los Angeles 45, Calif.

*Name furnished on request.
**Trade Mark Reg.

**FARR COMPANY**
*Manufacturing Engineers*
Los Angeles • Chicago • New York
Mf'd under license by
Control Equipment Co. Ltd. Montreal

STILL YOUR BEST BUY...

Where pipes meet permanently...

W-S FORGED FITTINGS

in CARBON, ALLOY and STAINLESS STEELS

. . . Still your best buy, because W-S longer service life and increased dependability give that permanency which will lower maintenance costs . . . They are drop forged.

Basic materials are selected from a wide choice of carbon, stainless and alloy steels and then subjected to the most exacting metallurgical controls from melt to bar. Through these precautions and subsequent precision machining operations, W-S assures the utmost in accuracy of finish, perfection of threads, sockets, angles and concentricity. All W-S Fittings, — Screwed and Socket Welding Types, — are finally instrument inspected.

W-S Bulletin A3-50 details the Carbon Steel Line. Bulletin S-1 is devoted to Stainless and the Alloys. W-S will gladly furnish information on the new FEATHERLITE Fittings — a recent big step in a wide range of services. Write today for the specific bulletin you desire.

Sold Through Leading Distributors

9-L-2

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WATSON-STILLMAN

Established 1848

ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

RHOADS Tannate UNI-PULL DRIVE

FOR TROUBLE-FREE POWER TRANSMISSION

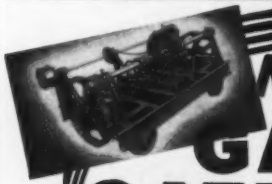
Every second, every minute, every hour —year in and year out—Rhoads Tannate UNI-PULL Drive assures smooth, consistent transmission of power. The pivoted motor base automatically maintains the proper belt tension regardless of fluctuating load conditions . . . and Rhoads Tannate Leather Belting, with its superior gripping surface that results from our exclusive tanning process assures long, trouble-free performance.

Write for Rhoads Tannate UNI-PULL Drive Manual.

PRODUCERS OF FINE LEATHER FOR 249 YEARS

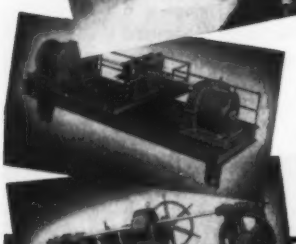
J. E. RHOADS & SONS

35 North Sixth Street, Philadelphia 6, Pa.



MURRAY GATES and GATE HOISTS

DESIGNED AND BUILT to meet all REQUIREMENTS for any Size Power Dam



From the smallest hand operated, to the large motor operated, MURRAY Gate Hoists are designed and built in a wide range of capacities, from less than 1 ton to over 100 tons. During our over half century of designing and building gate hoists, we have developed many designs for the different types of gate hoist problems. Perhaps we have several designs and patterns that will fit your requirements. In planning gates or gate hoists, we suggest you communicate with us before your plans for the project as a whole, are complete . . . it will save expense and much preparation time. We also build gate hoists especially from your plans and specifications, if desired.

*Our Engineering Department is at your service any time, to help you solve problems involving Power Dam Gates and Gate Hoists.*

D. J. MURRAY MANUFACTURING COMPANY

*Manufacturers Since 1883*

WAUSAU · WISCONSIN

## More APPOINTMENTS

Begins on page 232

there. George Armour becomes mgr of the Central region; W J Fritz, mgr of the Pacific Coast region; and George L Beauregarde, district sales mgr at Walla Walla, Wash. D Paul Bailey is director of market research.

Don L Hinmon becomes asst mgr of Transite pipe dept, **Johns-Manville Corp.**

**Link-Belt Co** elects Robert C Becherer executive v-p; Richard E Whinrey succeeds him as gen mgr of the Ewart plant, Indianapolis.

**Lincoln Electric Co** moves into supermodern plant at 22801 St. Clair Ave, Cleveland.

**Edward Valves, Inc,** moves its Pittsburgh, Pa. sales office to Room 2101 Investment Bldg, 235 Fourth Ave. Thomas E Skilling continues as dist sales mgr.

John L Ward becomes asst controller of **Corning Glass Works;** John L Hannigan is new gen mgr of electrical products; Norman J Vang is mgr of manufacturing; Paul T Clark mgr of pressware plant; Julian H Allen mgr of Fall Brook plant.

Cate Equipment Co, 49 E Ninth South, Salt Lake City, becomes district sales office for **Chain Belt Co.**

Walker L Cisler is elected to board of directors of **Detroit Edison Co.** He will become president and gen mgr in December, upon retirement of James W Parker.

**E L Dennis Engineering Co** moves to 5301 Canal Blvd, New Orleans 19, La.

General offices of **P E Madden & Co** are now at 1543 Morse Ave, Chicago 26.

New hydraulic sales mgr of North Central dist of **A O Smith Corp** is John B Madden; Alfred E Treen becomes mgr of personnel and purchasing at Houston; J G Goodwille is industrial safety-grating product supervisor.

C W Miller becomes mgr of large power transformer engineering at **Westinghouse Electric Corp** transformer div, Sharon, Pa. New executives for the jet engine plant at Columbus, Ohio, are C L Van Derau, gen works mgr in charge of both Mansfield and Columbus plants; E L Smith, works mgr, Columbus; C D Heaton, mgr of manufacturing; John B Roman, works engineer. At the electric appliance div, Mansfield, Ohio, P J Backman becomes works mgr; Dean B Fighter, mgr of manufacturing; Christ Reining, works engineer.

Harry A Holden will become mgr of Westinghouse's new Paris, Texas lamp div plant; Harry F Fox succeeds him as mgr of the Belleville, N. J. plant. Robert R Longwell becomes Baltimore engineering and service mgr; George E Grosser will be district consulting and application engineering supervisor, headquartering at

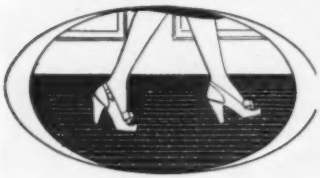
# No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

**NAVCO PIPING**

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

THE **SAFE**
OPEN STEEL FLOORING
IS **TRI-LOK**



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

**DRAVO CORPORATION**

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

KEWANEE®
HEAVY-DUTY

**10 to 304 hp**
**100, 125 and 150 lbs wp**

Has all the characteristics which make firebox boilers ideal for high pressure. Complies fully with ASME and SBI codes.

Outstanding for extra years of dependable service in producing hi-pressure steam economically with Oil, Gas or Coal.

*WRITE Department 96-K11-749*
*for 6" scale with pipe diameter markings*

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

## More APPOINTMENTS

*Begins on page 232*

Philadelphia. John W Schaffer is promoted to staff of E Pittsburgh div gen mgr, and Clark C Frame succeeds him as industrial relations mgr.

**Wagner Electric Corp** appoints M B Atkinson mgr of the Detroit electrical div office, and A W Maas mgr of the San Francisco electrical office.

Robert P Bremner becomes asst to v-p in charge of operations for **Youngstown Sheet and Tube Co.**

**Yale & Towne Mfg Co** appoints Frank P Minnelli mgr of new market research dept.

**Graybar Electric Co** appoints W G Wehe district operating mgr at Detroit. John Reine becomes Minneapolis district mgr; F A Siogren is mgr of the Duluth branch; P D Barber mgr at Portland, Ore; H J Mittelstaedt is operating mgr at Flint, Mich. W E Guy is elected to the board of directors.

L F A Mitchell becomes div product sales mgr for **General Cable Corp.**

**Reliance Electric & Engineering Co** appoints Paul W Arnold executive asst to sales v-p, and Richard A Geuder mgr of applied engineering and industry sales.

**Nordberg Mfg Co** appoints Bruno V Nordberg as sales engineer, 4-cyle engine dept.

New company, **Norton Behr-Manning Overseas, Inc,** will handle export business and direct world-wide subsidiary plant operations of Norton Co and Behr-Manning Corp.

**Norton Co** appoints Olavi J Warpula resident demonstrator for grinding machine div, and John C Ewer managing director of Norton Grinding Wheel Co Ltd, England.

Western div sales office of **Wheelco Instruments Co** moves to 2320 Milwaukee Ave, Chicago.

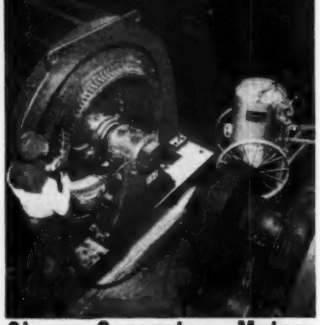
**Dowell, Inc,** promotes Claude H Groom to asst sales development mgr.

W Cordes Snyder Jr is elected president and chief executive officer of **Blaw-Knox Co.**

**Flexitallic Gasket Co** adds new agents: Jno D Hiles Co, Inc, Pittsburgh; Engineering Products Co, Charlestown, W. Va; Chapman Engineering Sales Co, Cincinnati; De Haven Engineering Co, Indianapolis; Steel & Engineering Products Co, El Paso; Energy Control Corp, Philadelphia. Fleck Bros, Ltd, Vancouver, B. C. is new distributor.

**Johnson Service Co** announces opening of new branch office in South Bend, Ind. in charge of Andrew J Hunter.

PANGBORN AC-4
"CORN COB" Blast Machine



**Cleans Generators, Motors**

*Faster*
*Better*
*Cheaper*

***Eliminates Toxic Hazard of Solvents!***

THE new portable Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. in ⅓ the time of other methods. Material costs are reduced 90% and toxic or explosive solvents are eliminated.

***Look at the savings shown by this recent test on electric motors.*** (Name of Company on request.)

| Cleaning Duplicate 500 hp Synchronous Motors | | |
|---|---|---|
| | Material | Labor |
| Solvent Method | $55.00 | 120 hrs. |
| PANGBORN Method | 5.00 | 40 hrs. |
| SAVING | 50.00 (90.9%) | 80 hrs. (66.7%) |
| Remarks: With Solvent, drying period took an additional 8 hours. | | |

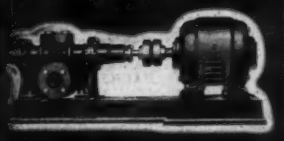
**SIMPLE OPERATION**

New Pangborn AC-4 Blast Machines use standard 40-pound air supply to remove oil and greases with blast of soft, 20-mesh corncob grits. No residue left on parts . . . no drying period.

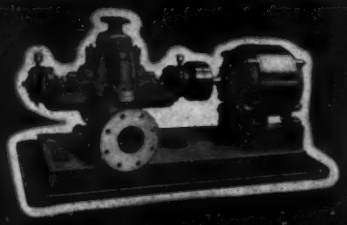
**FOR FULL INFORMATION,** write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

*Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment*

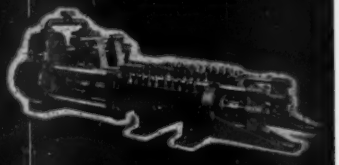
**Pangborn**
**BLAST CLEANS CHEAPER**
**with the right equipment**
**for every job**



Warren-Quimby
Gear-in head Screw Pump



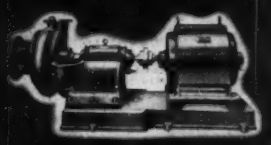
Warren Condensate Pump



Warren Horizontal Duplex
Hydraulic Pump

# WARREN PUMPS

*Maintain efficiency • Operate at low cost • Are long-lived*



Warren Type "L" Single-Stage
Single-Suction Liquor Pump

**CENTRIFUGAL**
Single and Multi-stage
Pressure range: Up to 1200 P. S. I.
Capacities: Up to 50,000 G. P. M.
Types: Horizontal and Vertical
Impellers: Open or Enclosed

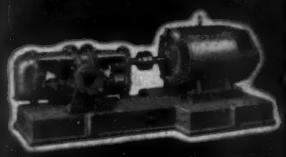
**RECIPROCATING**
Horizontal and Vertical Single Piston
Horizontal and Vertical Duplex Piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.,

**WARREN-QUIMBY SCREW PUMPS**
Gear-in-head and External Gear and Bearing
Capacities: Up to 3000 G. P. M.
Pressures: Up to 200 P. S. I. on low viscosity liquids; practically unlimited on high viscosity liquids
Horizontal or Vertical Mounting

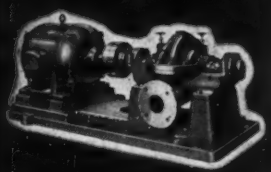
**WARREN-QUIMBY ROTARY PUMPS**
Gear-in-head and External Gear and Bearing
Capacities: Up to 1000 G. P. M.
Pressures: Up to 250 P. S. I.
Horizontal or Vertical Mounted

*Send your pumping problem to us, Warren Engineers will recommend the right pump for the job.*

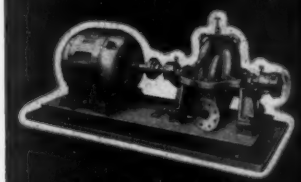
P-78



Warren-Quimby External Gear
and Bearing Rotex Pump



Warren Type DBL, Single-Stage
Double Suction, Centrifugal Pump

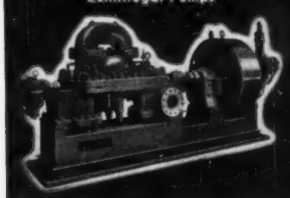


Warren Two-Stage Volute
Centrifugal Pump

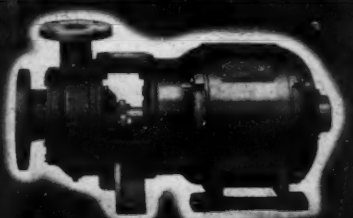
WARREN
QUIMBY PUMPS

## WARREN STEAM PUMP COMPANY, INC.

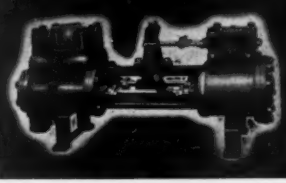
WARREN, MASSACHUSETTS



Warren 4- and 6-Stage
Centrifugal Pumps



Warren "Compacunit"—4 Types—42 Sizes



Warren Horizontal "Realwear"
Duplex Piston Pump

A SHORT STATEMENT ON

# STEAM TRAPS

THAT IS LONG ON GOOD SENSE:

A Steam Trap has but *one* function—to drain condensate from steam lines. Right?

Now if one brand of Steam Trap can drain *twice* as much condensate $ $ = $ under equal conditions, as another of the same size and price—it's just plain common sense to buy that brand, isn't it?

Clark DUO-STEP LEVERAGE STEAM TRAPS have proved in tests time and time again that they *can* drain *twice* the condensate of ordinary traps.

So—do as thousands of smart steam engineers have done:

SWITCH TO CLARK DUO-STEP STEAM TRAPS FOR DOUBLE DRAINAGE EFFICIENCY!

THE CLARK MANUFACTURING COMPANY
1831 East 38th St. • Cleveland 14, Ohio

Clark
THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

## More FREE BULLETINS

Continued from page 208

sizes, vacuum to 1000 psi. Made of stainless steel and heat- and corrosion-resistant alloys. 40-page catalog No. 51. Solar Aircraft Co, 2200 Pacific Hwy, San Diego 12, Calif.

**B53 ASBESTOS PACKINGS**—Braided, twisted, oil-resistant types. For valve stems, high-pressure and temperature steam, pump service. Size, weight, service recommendations, illustrations. 8-page bulletin. Raybestos-Manhattan, Inc, Packing Division, Manheim, Pa.

### PUMPS AND PRIME MOVERS

**B54 CONTROLLED VOLUME PUMPS**—Motor-driven or air-powered units. Pump liquids from 3 ml per hr to 50 gal per minute, against pressures to 25,000 psi. Automatic controls. For boiler-water treatment, automatic pH control, pressure generators, etc. 24-page bulletin No. 151. Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.

**B55 SUPAIRTHERMAL ENGINE**—For diesel, duafuel and spark-fired gas operation. 4-cycle types for stationary and marine service, 425 to 3200 bhp. Produces 1/3 more hp than turbocharged engine. 12-page bulletin No. 191. Nordberg Mfg Co, Milwaukee 7, Wis.

### WATER TREATMENT

**B56 ION-EXCHANGE MATERIALS**—Water-treating resins. Physical characteristics, exchange capacities, regeneration techniques. 16-page bulletin No. 57 on Nalcite SAR (basic anion exchanger); 28-page bulletin No. 58 on Nalcite HCR (styrene-type cation exchanger); 6-page bulletin No. 59 on Super Nalcolite (synthetic gel type zeolite for cation exchange). National Aluminate Corp, 6222 W 66th Place, Chicago 38, Ill.

### WELDING

**B57 WELDING ELECTRODES** — And welder's vest-pocket guide. Handy reference booklet. Metals and electrodes, types of electrodes, proper procedure, types of joints, weld characteristics, causes of troubles, electrical consumption. Illustrations, photos, tables. 40 pages. Hobart Bros Co, Box EW-161S, Troy, Ohio.

**B58 ARC-WELDING ELECTRODES**—Nickel-molybdenum-vanadium alloy steel, shielded. Low-hydrogen type. Meet Navy spec MIL-E-986 grade 260. 20-page reprint from Journal of American Soc of Naval Engineers. Operating characteristics, welding procedure. International Nickel Co, Inc, Dept EZ, New York 5, N. Y.

**B59 RESISTANCE WELDING**—Of nickel and high nickel alloys. 32-page technical bulletin No. T-33. Techniques, tables on mechanical properties, chemical compositions, conditions for welding. International Nickel Co, Inc, Technical Service Section, 67 Wall St, New York 5, N. Y.

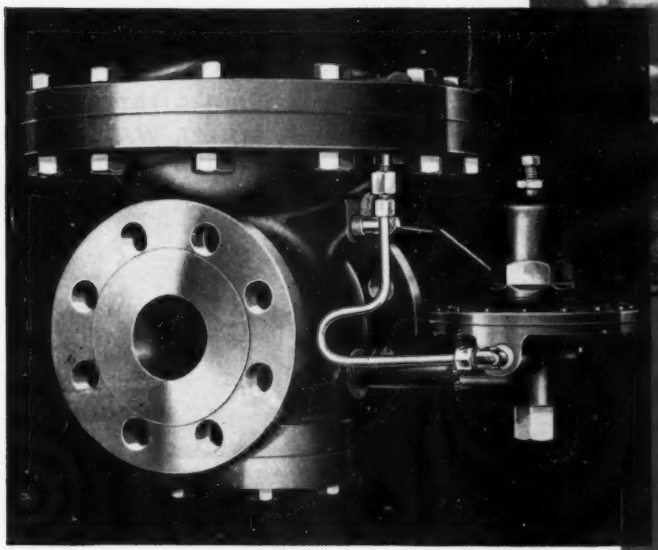
**B60 ELECTRODE FOR CAST IRON**—Carbon content in deposited metal evenly distributed. Weld metal similar to high-tensile, high-carbon steel. Details, specifications, data sheets. Eutectrode 26. Eutectic Welding Alloys Corp, Dept P, 172nd and Northern Blvd, Flushing, N. Y.

**B61 WELDING ALLOYS CHART**—For low-temperature welding. Specifications on over 175 metal-joining alloys. Bonding temperatures, tensile strengths, recommended uses, heating methods. 10x14 in. Eutectic Welding Alloys Corp, Dept P, 172nd and Northern Blvd, Flushing, N. Y.

**B62 BRAZING**—Sheet and cast aluminum. Easy instructions. 4-page folder. All State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y.

THE *Old Faithful*

*OF STEAM PRESSURE REDUCTION*



**FISHER® TYPE 92A**

**PILOT OPERATED CONTROL VALVE**

**ACCURATE**

Pilot Governor—with its extreme sensitivity to flow changes—maintains the desired reduced pressure with remarkable accuracy. No auxiliary pilot operating medium is needed.

**FLEXIBLE**

Two pilot assemblies for high or low pressure service are available and interchangeable on all Type 92A sizes. Pilot control spring easily adjusted or changed to obtain a variety of reduced pressure ranges. Lends itself to stocking to meet wide variety of operating conditions.

## *BUILT FOR UNFAILING SERVICE*

Power engineers everywhere have ok'd the **Fisher Type 92A** for steam pressure control! It's an accurate, compact, flexible, sturdy controller, designed, built and proved to meet the **most exacting requirements** for steam service.

### SINGLE SEATED • TIGHT CLOSURE

The single seated hardened stainless steel construction assures tight closure and prevents excessive pressure build-up. Sizes: ½" to 2" screwed; 1" to 6" flanged. Reduced pressure ranges 3 to 200 PSI. Inlet pressure up to 250 PSI at 450° F. Pilot inner valve and seat of hardened stainless steel to give long life under wire drawing conditions.

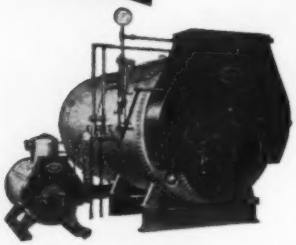
**Fisher Bulletin C-3 gives full details. Write for your copy today.**

**FISHER GOVERNOR CO.**

**MARSHALLTOWN, IOWA**

A BOILER With Economy

A LEFFEL Scotch Boiler!



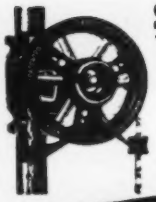
Users of self-contained, compact Leffel boilers report fuel savings of from 20 to 40 percent over other types. The 17 sizes are available in ratings of from 6 to 250 *actual* horsepower. And the sturdy, dependable construction of all Leffel boilers permits substantial overloading with safety. Designed to burn COAL, GAS, or OIL, they are easily converted from one fuel to another. There is an efficient Leffel Scotch type boiler, easy to install, ready to go to work in your plant . . . today!

Write for descriptive catalog

**The James Leffel & Co.**

DEPT. O SPRINGFIELD, OHIO





SIMPLIFIES OVERHEAD VALVE CONTROL

**Babbitt** —Adjustable— SPROCKET RIM with Chain Guide

• Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

• Pull the chain! That's all there is to open or close overhead valves—for complete control from the floor! Operating action of the BABBITT Adjustable Sprocket Rim with Chain Guide is as positive and instantaneous as that of direct manual control—and 100% safer because the dangers of climbing treacherous stepladders, or on benches, machines or boilers is completely eliminated.

• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

• *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

**BABBITT STEAM SPECIALTY CO.**

1 Babbitt Square, New Bedford, Mass.



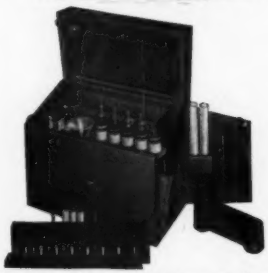
KEEP

SCALE

TO A MINIMUM

CHECK BOILER WATER FOR pH AND PHOSPHATE

IT'S FAST AND EASY WITH A TAYLOR BOILER WATER COMPARATOR!



It takes only a minute or two to determine pH or Phosphate, since all color standards necessary for a determination are enclosed in one plastic slide . . . no breakable single standards to handle. Maximum accuracy is assured . . . *for all Taylor Liquid Color Standards carry an UNLIMITED guarantee against fading.* Their low cost, extreme accuracy and simplicity of operation have made Taylor Boiler Water Comparators the accepted tool throughout industry.

Model P contains either High or Low Phosphate Comparator. Model W (shown above) contains same, plus 3 pH slides (pH 7.2 to 8.8); (pH 8.6 to 10.2); (pH 10 to 11.6) plus accessories and instructions for use.

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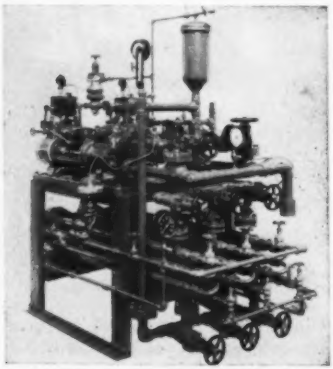

*The compact, high-pressure unit illustrated consists of two Worthington Duplex Steam Pumps and three Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.*

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

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*And Only A*

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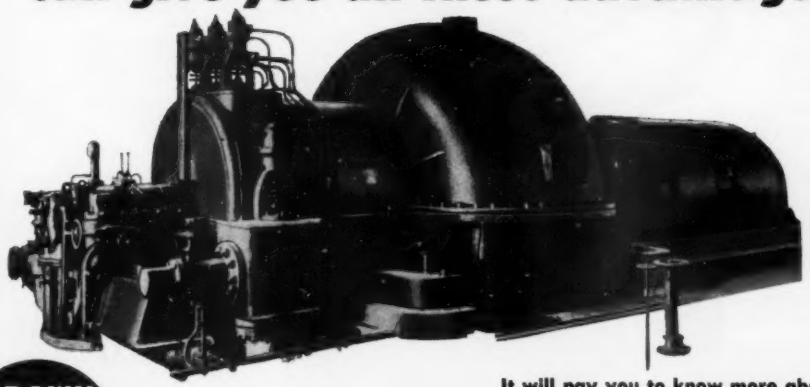
***can give you all these advantages***



**It will pay you to know more about Brown Boveri Turbo Generators.**

*Write for descriptive data.*

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**BROWN BOVERI CORPORATION**

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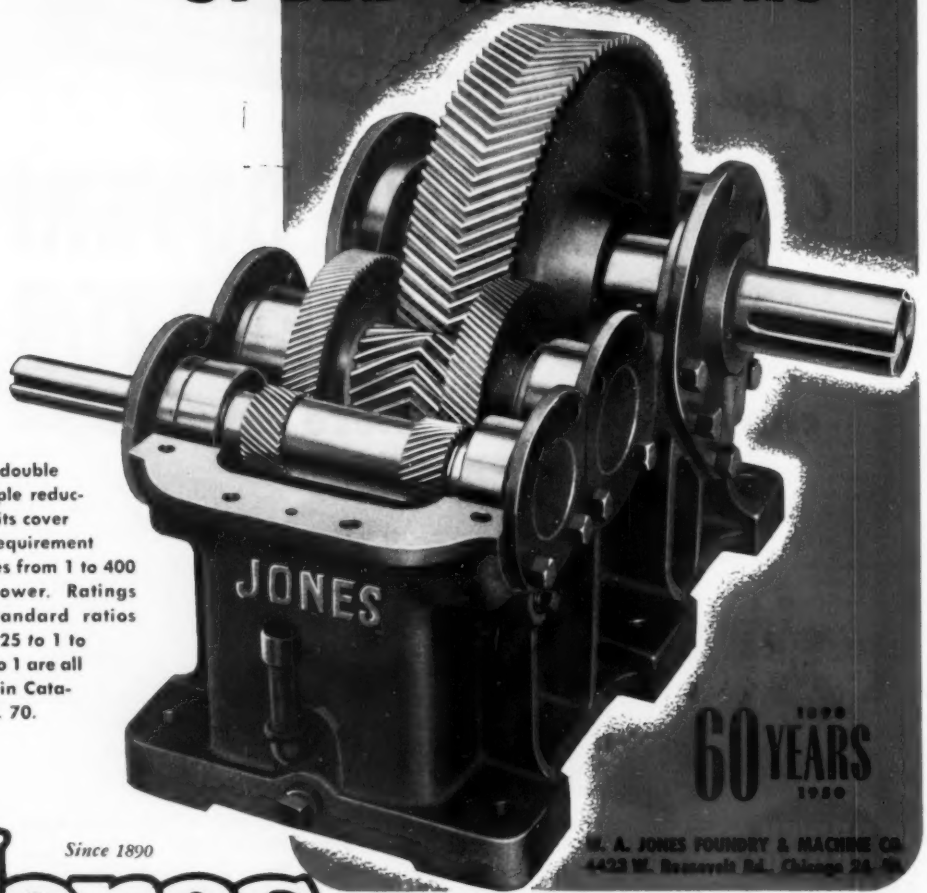


Single, double and triple reduction units cover every requirement in drives from 1 to 400 horsepower. Ratings and standard ratios from 1.25 to 1 to 355.8 to 1 are all shown in Catalog No. 70.

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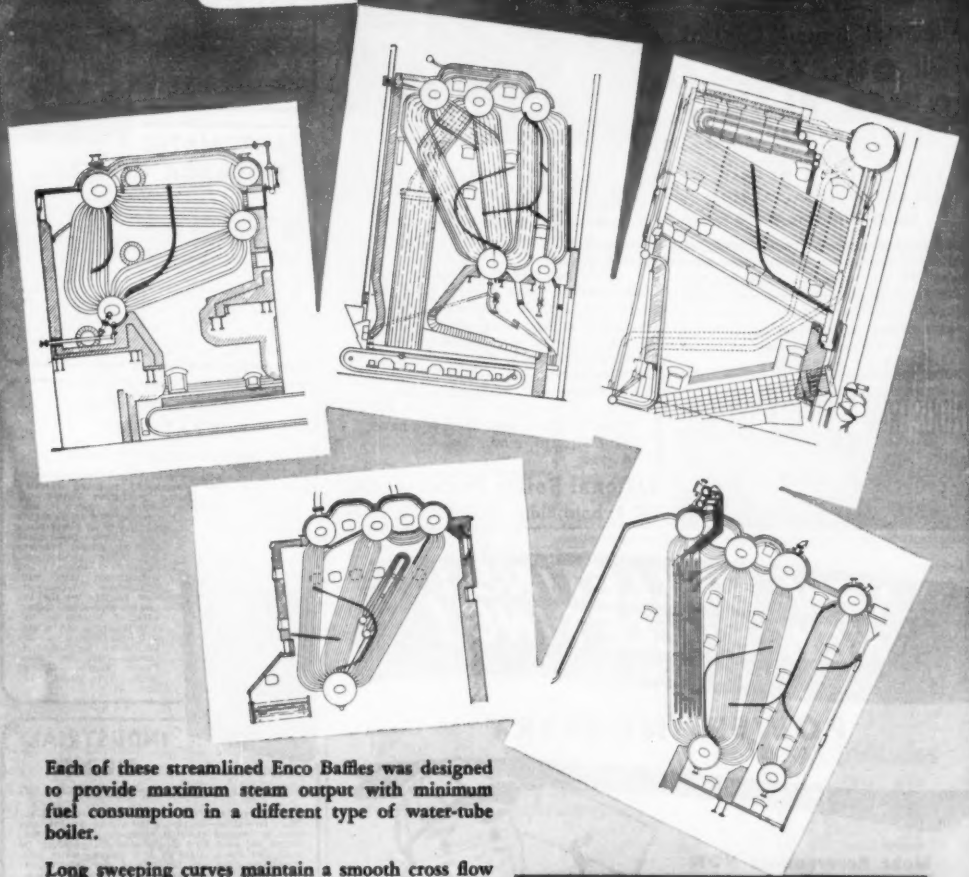
# *Streamlined for Savings*
## IN EVERY TYPE OF BOILER



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Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your **FREE** copy today?

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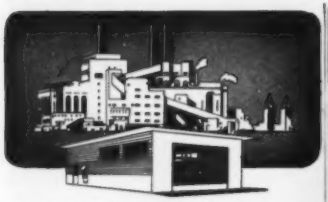

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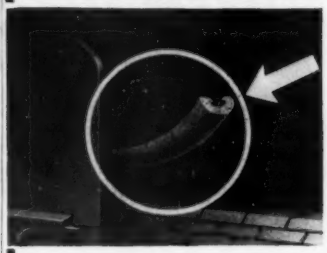

The outside laps of the plates at the girth seams of riveted HRT boilers are liable to buckling and cracking, due to overheating. Often the rear head seam is similarly affected.

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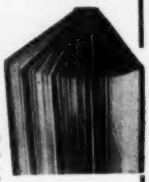

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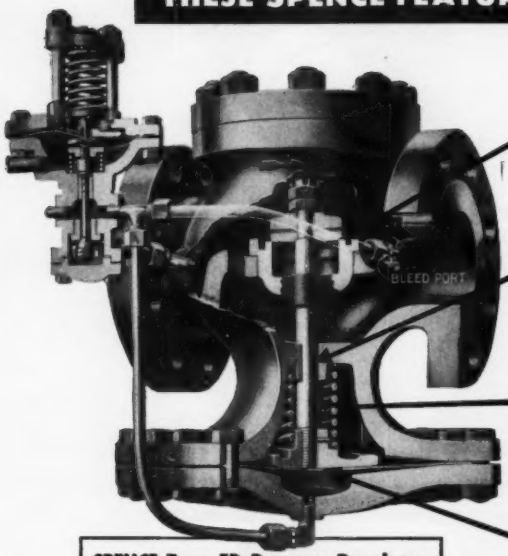


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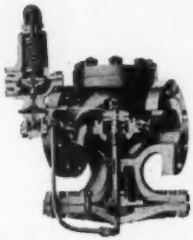
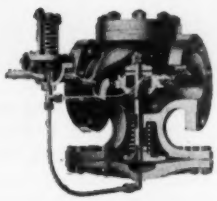


Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



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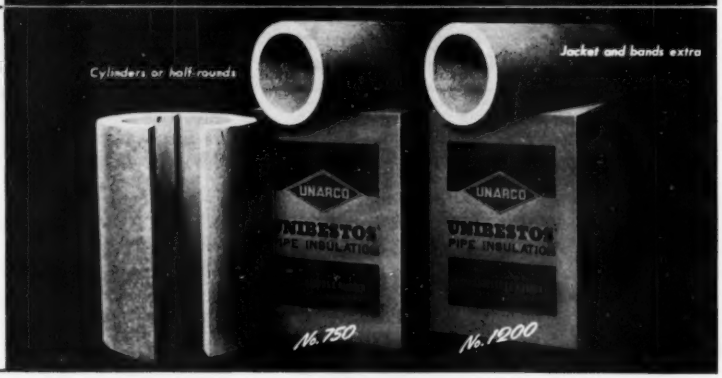


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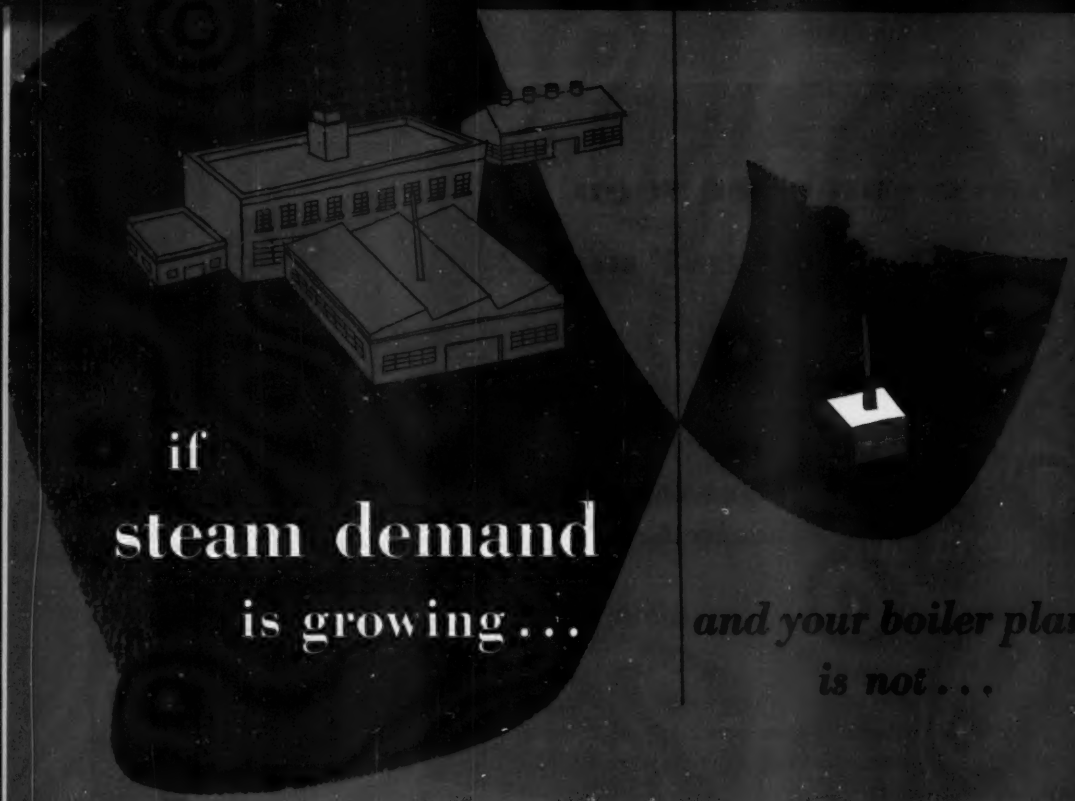

# if steam demand is growing . . .

## *and your boiler plant is not . . .*

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### can help you bridge the gap

* A service, by our technically trained representatives, designed to help you get MORE from your fuel. Available at no cost or obligation in areas covered by Beacon Coal Sales Offices.

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Maybe the B.C.S. Man can help YOUR plant develop a new set of muscles. Why not see?

*NOTE TO COAL DEALERS: If any of your commercial or industrial customers or prospects have a problem like this, your B.C.S. Man will be glad to work with you in determining the cause and recommending a solution.*

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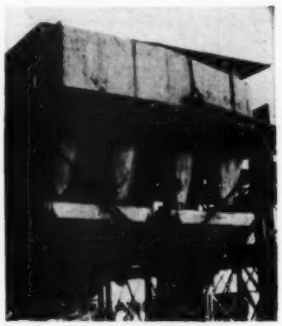

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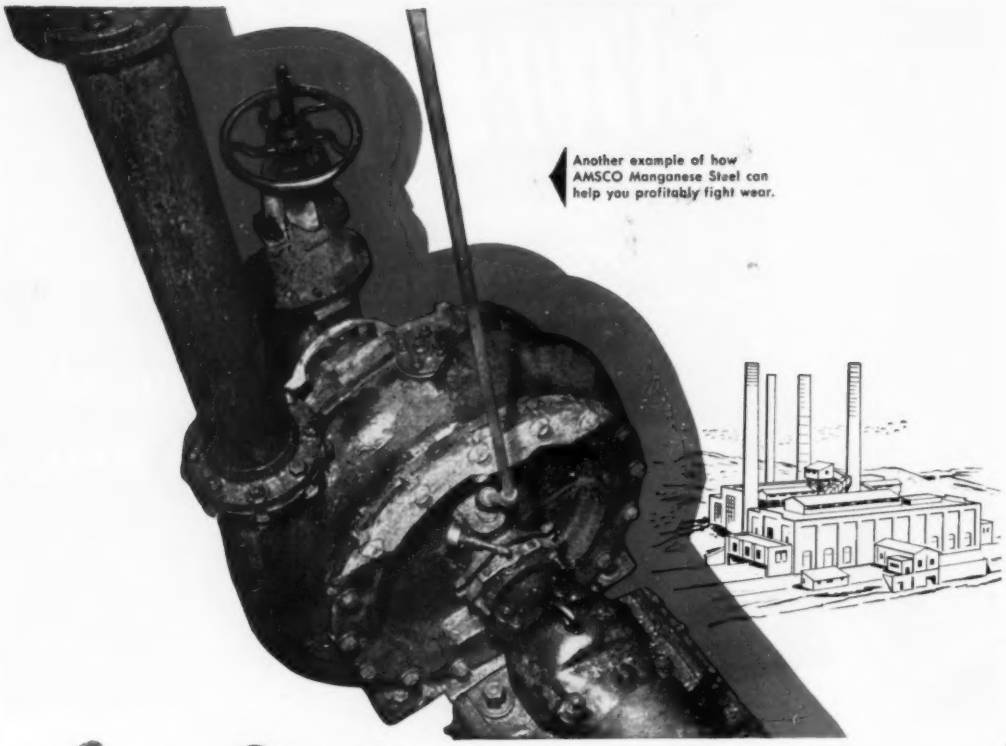

Another example of how AMSCO Manganese Steel can help you profitably fight wear.

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## How an AMSCO Materials Handling Pump saved 65% on ash disposal costs

The Central Illinois Electric and Gas Co. at Rockford can speak with authority on the efficiency of AMSCO Materials Handling Pumps. They've been using these tough, wear-resistant pumps for 30 years! The photo above shows one of the first, if not *the* first pump of any make, used for ash disposal. This AMSCO Pump installation was put in service in June, 1921 and it's still in operation.

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These AMSCO Pumps are designed—and precision made—for a combination of efficiency and rugged service that means real economy. That's why so many hundreds of successful installations have been made since this first one in 1921.

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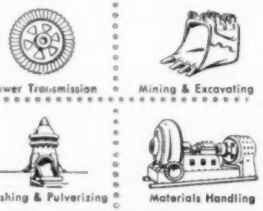
**AMSCO** controls impact and abrasive wear in 5 basic industrial operations:

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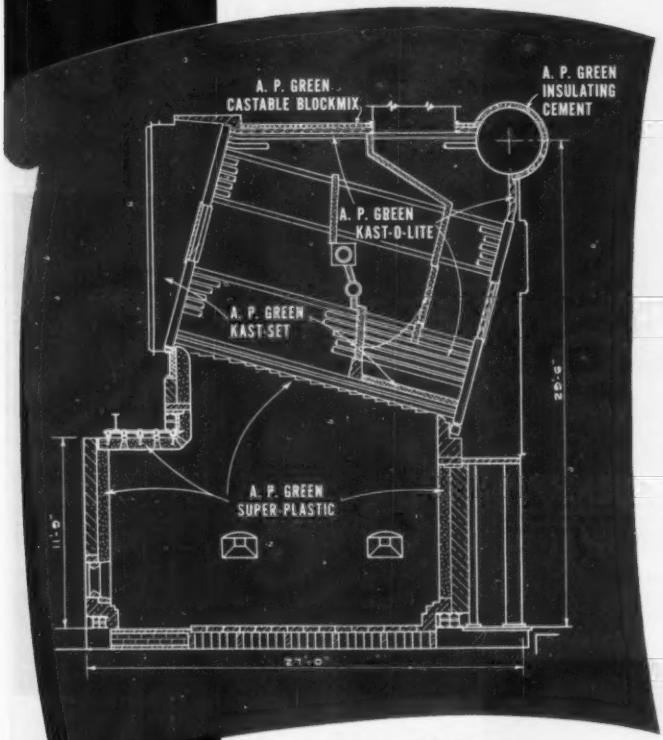


One of the country's leading oil refining companies is using A. P. Green refractories and insulating materials exclusively in resetting 12 water tube boilers. This tremendous job requires over 1200 tons of plastic firebrick, refractory and insulating castables and firebrick as shown by the drawing. All 12 of the water tube boilers are of the same size.

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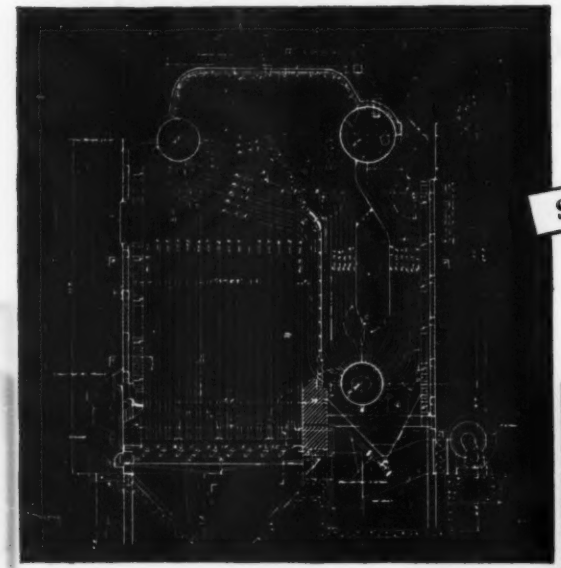
City.....Zone.....State.....

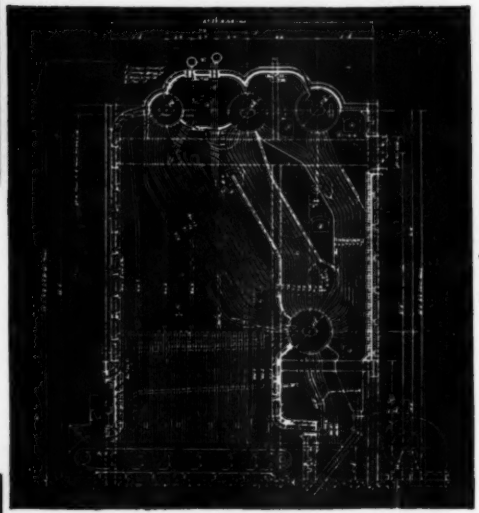
# Quick Steaming at all Ratings!



**Carry high overloads with high efficiency**

**SPECIFY Vogt**

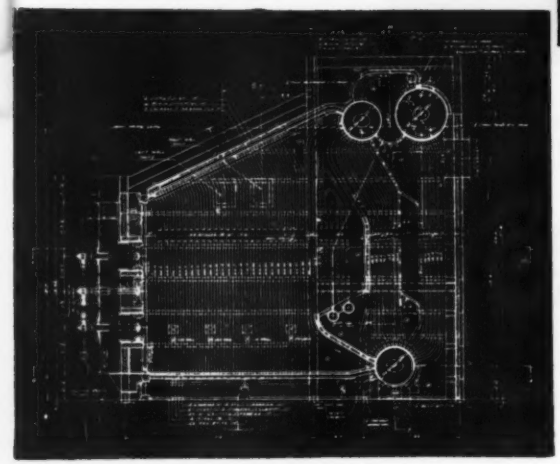
**STEAM GENERATING UNITS**



**CLASS VL** Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

**CLASS LE** Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

**CLASS VR** 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.

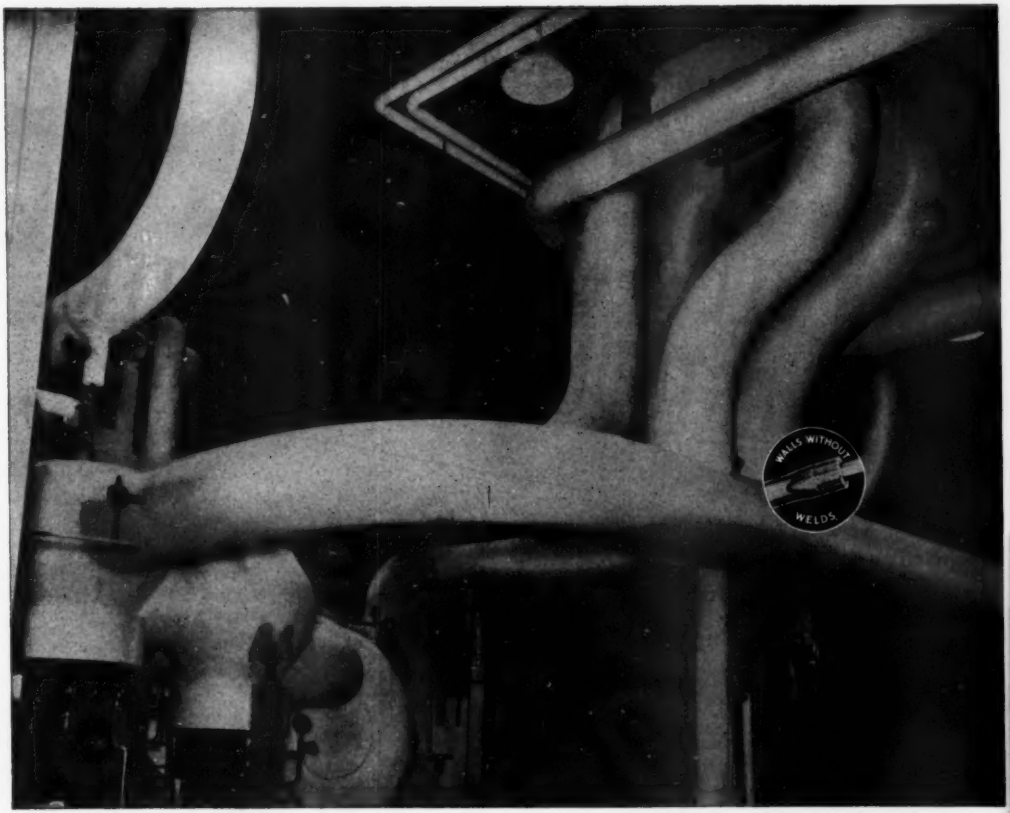


Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

## HENRY VOGT MACHINE CO.

**LOUISVILLE 10, KENTUCKY**

BRANCH OFFICES:
NEW YORK, PHILADELPHIA, CLEVELAND
CHICAGO, ST. LOUIS, DALLAS




# First commercial mercury-unit power plant uses Seamless Alloy Tubing

▶ The plant is the Schiller Station of Public Service Company of New Hampshire. When operating at designed rate of 40,000 Kw and using Bunker C fuel oil, the heat rate is *9,200 Btu per net Kw hr.* Temperatures are very high with resultant higher creep stresses and increased oxidation hazards.

This great advancement in design called for tubing that was completely reliable. To meet this requirement, all piping was National *Seamless* Alloy Tubing; ½ chromium, ½ molybdenum. The extra strength and uniformity of this National Seamless Tubing added the finishing touch to a beautiful job of designing.

• • •

When you plan for future construction, check the service records of National Seamless Pipe and Tubing. It's our premier product—actually pierced from a billet of high quality steel. There are no longitudinal welds, which means absolutely uniform wall strength.

**NATIONAL TUBE COMPANY, Pittsburgh, Pa.**
*(Tubing Specialties Division)*
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

**NATIONAL *Seamless* PIPE AND TUBING**

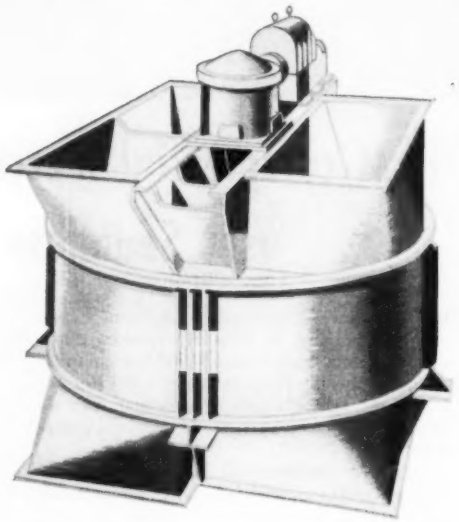
**UNITED STATES STEEL**

# GET ALL 3 with the LJUNGSTROM AIR PREHEATER

- Improved Combustion
- Better Heat Recovery
- Plant Material Savings

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

If you want to improve the combustion of low-grade fuels . . . raise the level of heat recovery . . . conserve critical materials in plant design . . . you or your consultants can make profitable use of Preheater experience. Let our specialists tell you more about the Ljungstrom Air Preheater, and the outstanding job it has done for hundreds of America's leading industries and public utilities, where the need for preheated air from 300F to approximately 1200F was part of their problem. Our engineers are ready to work with you in applying the Ljungstrom to your own heat recovery problem.

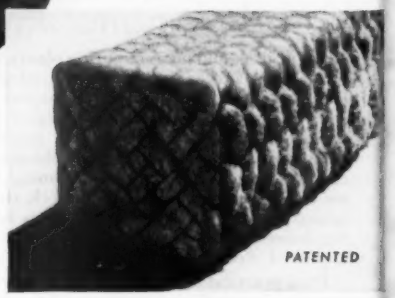


## THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

# Today you need a packing that lasts longer

HERE IT IS




Now, when you must meet tight production schedules, you'll need GARLOCK *Lattice-Braid* to help you avoid frequent shut-downs for re-packing—for *Lattice-Braid* is designed for long, continuous service.

All the strands of *Lattice-Braid* packing are lattice-linked together into a structural unit which holds together, even when the packing is worn far beyond the limits of wear of ordinary braided packings.

GARLOCK *Lattice-Braid* is supplied in several styles listed at the right. Write for folder today.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

## GARLOCK *Lattice-Braid* PACKING

**ASBESTOS**

GARLOCK 730-for hot or cold water at medium to high pressures.

GARLOCK 731-for steam, gases or water at temperatures up to 700°F.

GARLOCK 732 (wire inserted)-for heavy duty service against steam, oil, gases or water at temperatures up to 700°F.

GARLOCK 733-for hot or cold water or alcohol at medium or low pressures.

GARLOCK 734-for cold gasoline, kerosene and light oils.

GARLOCK 736 (blue asbestos)-for concentrated mineral acids.

**FLAX**

GARLOCK 740-for cold water at medium or low pressures.

GARLOCK 745-for heavy hydraulic service against cold water.

**COTTON**

GARLOCK 751-for hot or cold water.

**TEFLON**

GARLOCK 5733-for all acids, all alkali solutions and all organic solvents.

POWER STATION

***For quiet engine exhausts and compressor intakes--- select***

*Burgess-Manning Snubbers*

● In utilities and manufacturing plants, on Diesel locomotives and boats, in the chemical and petroleum industries . . on engines and compressors of all sizes and makes, you will find Burgess - Manning Snubbers effectively quieting the pulsating roar from engine exhausts and the throbbing suction of compressor intakes. Burgess - Manning Snubbers are scientifically designed to smooth the flow of exhaust gases and intake air. Noise is reduced to the desired sound level. Performance of equipment improved. Reduced maintenance.

For a practical solution of your engine and compressor noise problems call Burgess-Manning: sound engineering recommendations; sturdily constructed, reliable products; guaranteed performance.

**BURGESS-MANNING COMPANY**

749 East Park Avenue, Libertyville, Illinois

YOU CAN DEPEND UPON BURGESS-MANNING ENGINEERS FOR A QUALITY PRODUCT AND SOUND ENGINEERING COUNSEL

- A quarter century's experience.
- Engineering and installation know-how gained by work in hundreds of industries.
- Broad line of Snubbers in a wide range of sizes and noise reduction capacities.

*Write for Bulletin*
"Bring Your Plant Up To Date With Burgess-Manning Heavy - Duty Slug Buster Snubber."

PIPE LINE STATION

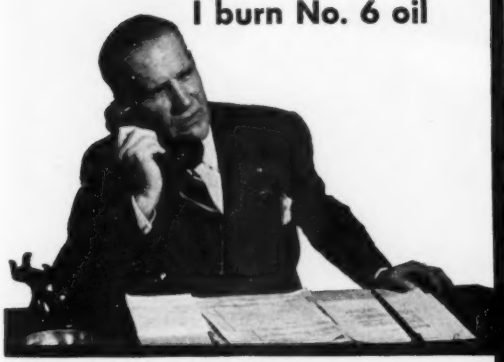
BARGE

ENGINE TEST HOUSE

DIESEL LOCOMOTIVE

1.

**That's right!**
**I burn No. 6 oil**



2.

**No, not a bit of trouble!**

3.

**Yes, it's a Preferred.**
**They specialize . . .**

4.

**. . . in fully* automatic operation with residual fuels!**

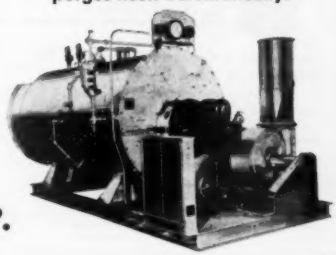
That plant engineer is only one of hundreds who label us specialists in *fully* automatic operation with residual oils. We're proud of the title, of course, for we achieved what many folks said couldn't be done. But, actually, we at Preferred like to be thought of as all-around experts in combustion problems. Witness the complete Preferred line of gas, combination oil-and-gas and light oil-fired steam generators.

We tackled and solved the problem of residual oils, because we knew we could cut your production costs by $3,000 to $35,000 a year by reducing fuel costs. Scores of Preferred customers have already pocketed these savings. Like the engineer on the 'phone, they are burning No. 6 oil with *fully* *automatic operation.

If you are now using more expensive grades of fuel, discuss your installation with a Preferred representative or write for Bulletin 175 about the Preferred Horizontal Rotary Oil Burner and Bulletin 1000 which describes the Preferred Unit Steam Generator.

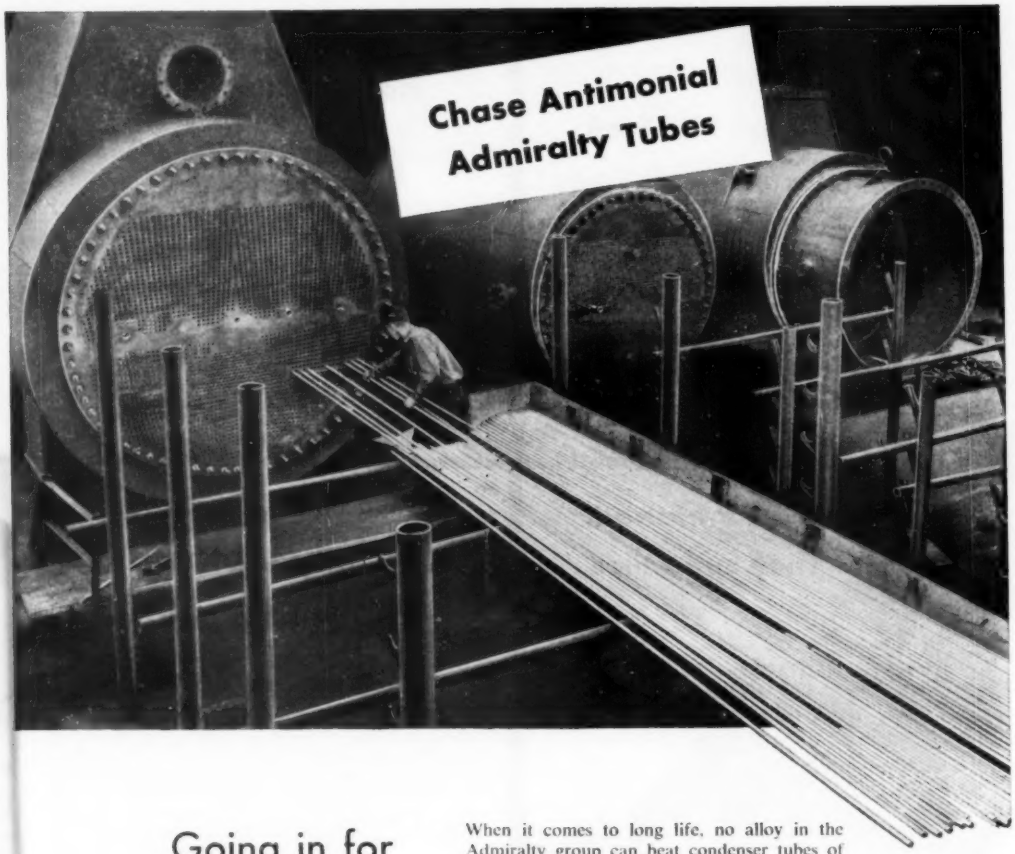
*What We Mean By *Fully Automatic* Operation

- Starts *automatically*
- Ignites *automatically*
- Starts at low fire and follows load *automatically*
- Shuts off, cleans and purges itself *automatically*.



**PREFERRED UTILITIES MANUFACTURING CORP.**
**1860 BROADWAY, NEW YORK 23, N. Y.**

PR-206




## Going in for years of service

When it comes to long life, no alloy in the Admiralty group can beat condenser tubes of Chase Antimonial Admiralty.*

Because these tubes have *enough* antimony, they resist dezincification. And antimony as an inhibitor doesn't affect the grain structure . . . will not weaken the tube.

For more information about long-lasting Chase Antimonial Admiralty . . . send coupon for FREE book on Condenser and Heat Exchanger Tubes.

**CHASE WAREHOUSE STOCKS:** *NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES.* Also carried by *Vinson Supply Co., Tulsa; Standard Brass & Mfg. Co., Houston.*

*U.S. Pat. No. 2,061,921

**FREE CHASE BOOK** discusses corrosion problems and selection of condenser and heat exchanger tubes for all applications.

**Chase Brass & Copper Co., Dept. PO 1151**
**Waterbury 20, Conn.**

*Please send me your Free Book on Condenser and Heat Exchanger Tubes.*

**Name** _____

**Position** _____

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**Street** _____

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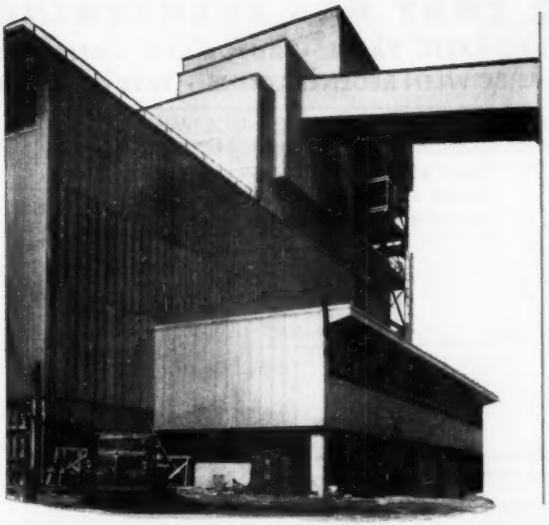
Chase® **BRASS & COPPER**

**WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION**

*• The Nation's Headquarters for Brass & Copper*

CHASE 75th ANNIVERSARY 1876 1951



# Another New Power Plant Conserves Heat–Saves Fuel . . .

with Carey

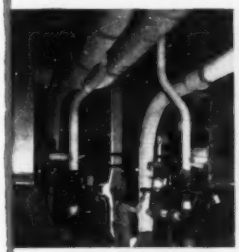
**INSULATION**

## *Hawthorn Station, Kansas City Power & Light Company*

This new steam-electric generating plant pours out a plentiful supply of cheap electricity for fast-growing industry and commerce, and thousands of farms and homes in the Company's Missouri-Kansas service area.

On the Missouri River in the Northeast Industrial District of Kansas City, Missouri, the new, modern Hawthorn Station has two 60/66,000 kw units in operation. An additional 90/99,000 kw reheat unit —to be ready for service late in 1952—will boost the utility's total generating capacity to a figure 103% greater than that of 1941!

Hawthorn Station, like *hundreds* of leading utility and industrial plants, installed Carey insulation products to save fuel and increase efficiency by minimizing heat loss. You cannot name a heat insulation problem that a Carey insulation product will not solve. And Carey's broad line includes *Super-Light* monolithic 85% magnesia in precision-sized blocks and "nesting O.D." pipe coverings that simplify installation, slash labor costs. Let Carey help you solve your heat insulation problems. Ask your Carey Industrial Sales Engineer for complete technical and application data—or, write to us direct.



Large pipe lines shown are 8" boiler feed discharge lines, carrying hot water from boiler feed pump to boiler drum. They are insulated with 2" thick Carey 85% Magnesia, finished with 8 ounce duck canvas. Small lines are 3" recirculating pipe lines, carrying water at 270° F., and insulated with 2" thick 85% Magnesia with 8 ounce duck canvas finish.

3", 4" and 6" pipes shown here carry saturated steam at a temperature of 350° F. to air heaters. They are insulated with double standard thickness Carey 85% Magnesia insulation.

The main steam header, carrying steam to the turbine at a temperature of 950° F., is a 12" pipe insulated with 2½" thick Carey Super-Light Monolithic 85% Magnesia over 2½" thick Carey Tempchek with sewn asbestos cloth finish.

**Write for your FREE copy**

*of "Industrial Insulation." Address Dep't P-11, The Philip Carey Mfg. Co., Cincinnati 15, Ohio. In Canada: The Philip Carey Co., Ltd., 277 Duke St., Montreal 3, P. Q.*

FROM THE HOUSE OF CAREY

Insulation • Built-up Roofing • Careystone Roofing and Siding • Careyduct • Asphalt Plank • Asphalt Paints and Coatings • Industrial Flooring • Other Famous Products for Industry

Carey

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio. In Canada: The Philip Carey Co., Ltd., Montreal 3, P. Q.

# A WATER SOFTENER THAT HAS EVERYTHING

## WIDE RANGE OF ZEOLITES • HYDROMATIC VALVE • AUTOMATIC CONTROLS
## PLENTY OF SOFT WATER • LONGER TIME BETWEEN REGENERATIONS • SAVE ON LABOR

COCHRANE ZEOLITE Water Softeners have been serving industry for generations. Modern improvements in the basically efficient Cochrane Softener make the apparatus of today the ideal softening equipment. A wide range of zeolite materials (siliceous and non-siliceous, greensand and synthetic) increase the capacity, and increase softening time between regenerations. The exclusive Cochrane Hydromatic Single Control Valve eliminates complicated "valve nests" and makes for easy, trouble-free operation. With the Hydromatic Valve arranged for automatic control, labor costs and maintenance costs are cut considerably.

*Write for details and a copy of Publication 4520.*

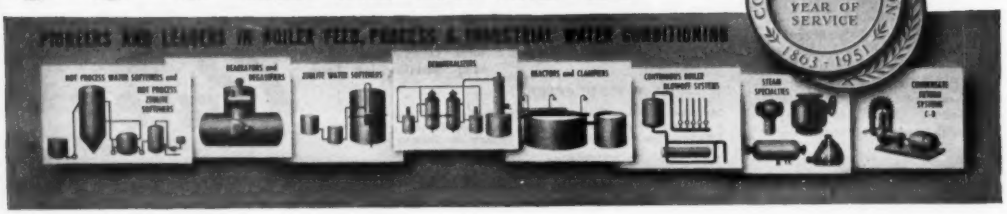
**COCHRANE CORPORATION**
**3106 N. 17th St., Philadelphia 32, Pa.**

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris

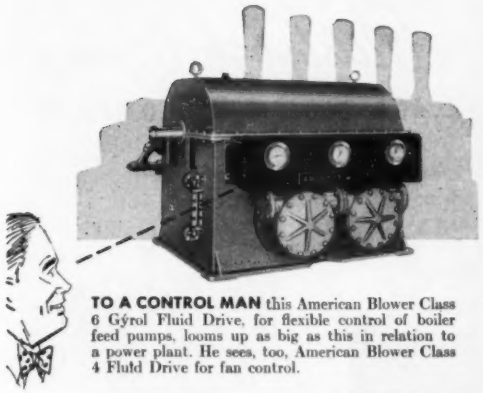
HYDROMATIC SINGLE CONTROL VALVE WITH INTEGRAL AUTOMATIC HYDRAULICALLY ACTUATED BACKWASH AND RINSE WATER FLOW RATE CONTROLLERS ELIMINATES NEED FOR SUMP TYPE CONTROLS
TREATED WATER OUTLET
CENTRAL CONNECTION FOR WATER AND BRINE DISTRIBUTORS
METER WITH ALARM CONTACTS
RAW WATER INLET DISTRIBUTOR
BRINE EDUCTOR
NON-FERROUS BRINE DISTRIBUTOR
ZEOLITE: RESINOUS, CARBONACEOUS, GREENSAND OR SILICA GEL TYPES
SAND & GRAVEL OR GRADED ANTHRACITE BRINE FILTER
RAW WATER TO HYDROMATIC VALVE
BRINE REGENERATING TANK
GRAVEL OR ANTHRACITE ZEOLITE SUPPORTING MEDIA
SCREW JACK LEGS
UNDERDRAIN DIFFUSOR
FUNNEL TO SEWER

The Cochrane Zeolite Softener with Hydromatic Valve arranged for Manual Operation

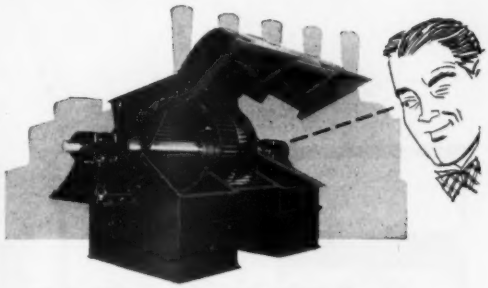
# COCHRANE



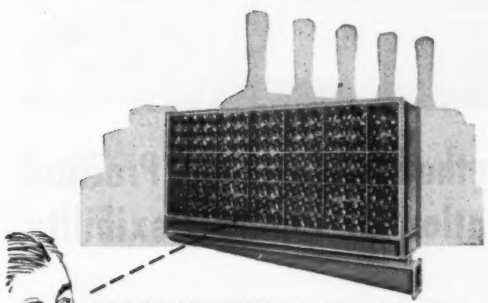
# It all depends on how you look at it



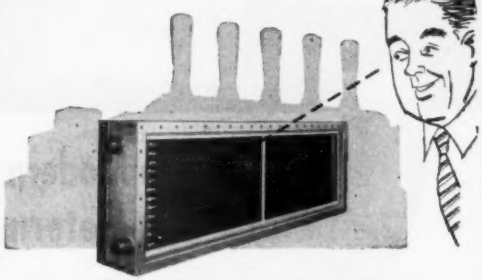
**TO A CONTROL MAN** this American Blower Class 6 Gyrol Fluid Drive, for flexible control of boiler feed pumps, looms up as big as this in relation to a power plant. He sees, too, American Blower Class 4 Fluid Drive for fan control.



**TO A MECHANICAL DRAFT MAN** a Sirocco Multi-Blade Fan, which delivers more gas per revolution than any other type, takes *this* proportion in the picture. He could see an American Blower HS Fan equally large if thinking of forced draft.



**TO A FLY ASH EXPERT** an American Blower Type ST Fly Ash Precipitator looks like this in relation to the rest of the power plant. Little wonder, for the Precipitator lifts a load off his shoulders and minimizes a nuisance.



**TO A COIL MAN** American Blower Heavy Duty Steam Coils would appear like this in his power plant picture. He likes their great strength, easy accessibility and the way they withstand the high pressures of heavy loads.

Looking at your complete power plant picture, we believe you'll find, as hundreds of others have, that all these American Blower Products improve over-all power-plant efficiency and insure years of dependable operation. Call our nearest Branch Office for complete data.

## AMERICAN BLOWER

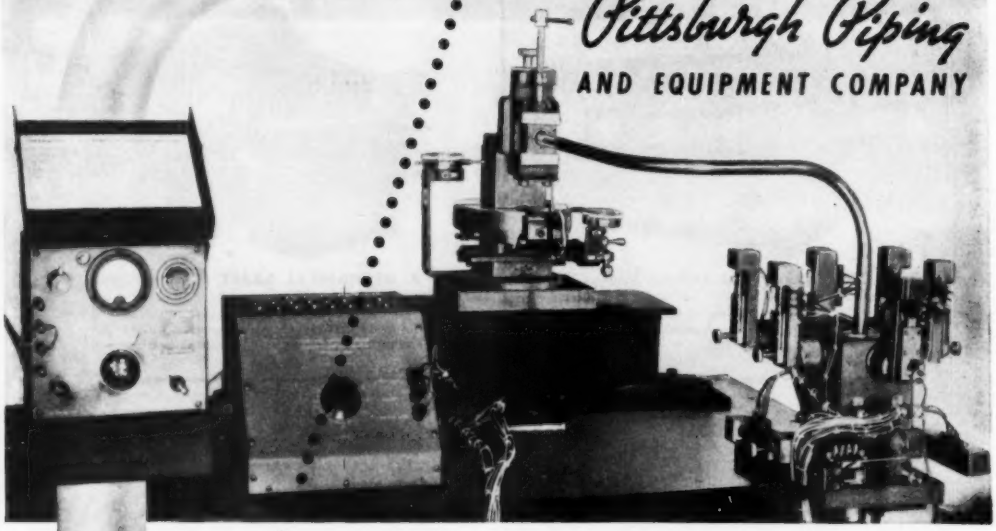
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

*Serving home and industry*

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

# Model Testing at Pittsburgh Piping AND EQUIPMENT COMPANY



## The Modern Method for Complete, Practical Pre-determination of Piping Flexibility

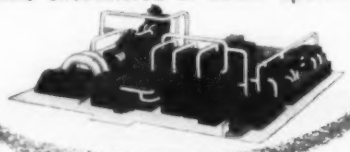
Model testing is one of the many technological advancements thoroughly investigated and proved by Pittsburgh Piping and Equipment Company before being made generally available. It provides complete advance knowledge of the reactions of any type, size, and system of power piping.

The testing apparatus shown above accurately measures and directly indicates the physical reactions of a section of pipe which exactly duplicates, in miniature, the planned layout. These measurements are projected to give precise information on the full size system as a check against theoretical calculations.

On complex piping layouts, model testing provides a complete analysis instead of theoretical approximation; it is a time and labor saver; and the possibility of mathematical error is minimized. Its use helps to avoid excessive stresses, reactions, and movements in the final system which could affect joints and thus cause leakage, or damage anchors and equipment connected to the pipe line.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

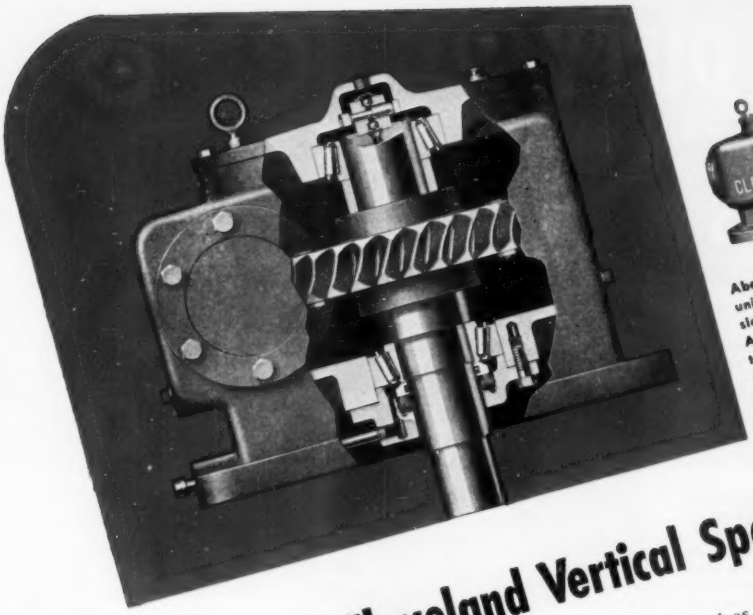
Model Testing makes possible the planning of high-pressure, high temperature piping systems with accurate advance knowledge of end reactions, stresses, and strains encountered in actual operation.



Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Bank Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston



**Above—Exterior view Type ND unit. NU unit (not shown) has slow-speed shaft extending up. At left—Cutaway section to show tapered roller bearings on gear shaft, positive face-type oil seal, unique lubricating pump and oil drain at base of housing.**

# A new series of Cleveland Vertical Speed Reducers

● NU and ND worm gear units—in seven sizes each (50 to 500) are ready for prompt delivery. They are particularly suited to such equipment as agitators and mixers, and to overhead chain conveyors as well.

Outstanding features which insure that these new vertical drives will deliver long and trouble-free service are:

**Extra heavy tapered roller bearings on gear shaft.**

**Continuous lubrication of top bearing by positively driven pump mounted on upper end of gear shaft (on lower end in Type NU).**

**Positive face-type oil seal below lower gear shaft bearing to prevent leakage.**

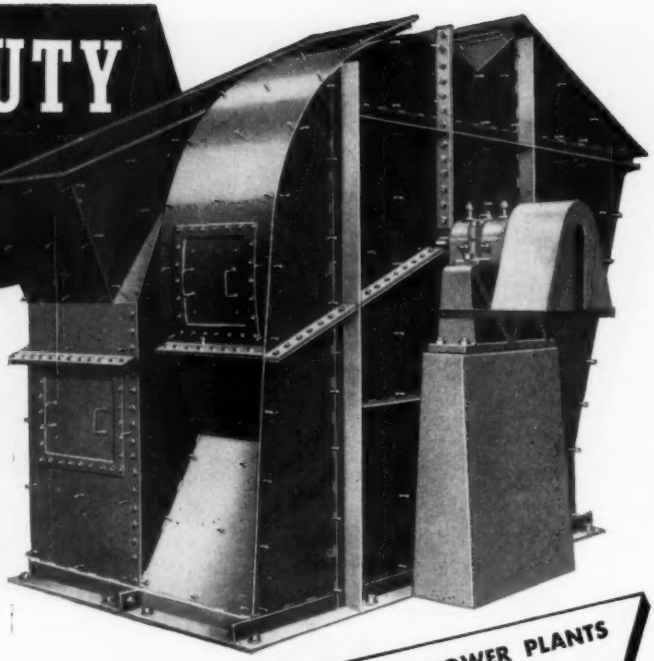
**Heavy base flange extends around all four sides. All parts liberally sized and precision built.**

Write for Bulletin 125 for full description of Types NU and ND, including capacity charts and dimension data. The Cleveland Worm & Gear Co., 3262 East 80th Street, Cleveland 4, Ohio.

*Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.*

**CLEVELAND**
**Worm Gear**
*Speed Reducers*

# HEAVY-DUTY
## for *Important*
# FAN JOBS

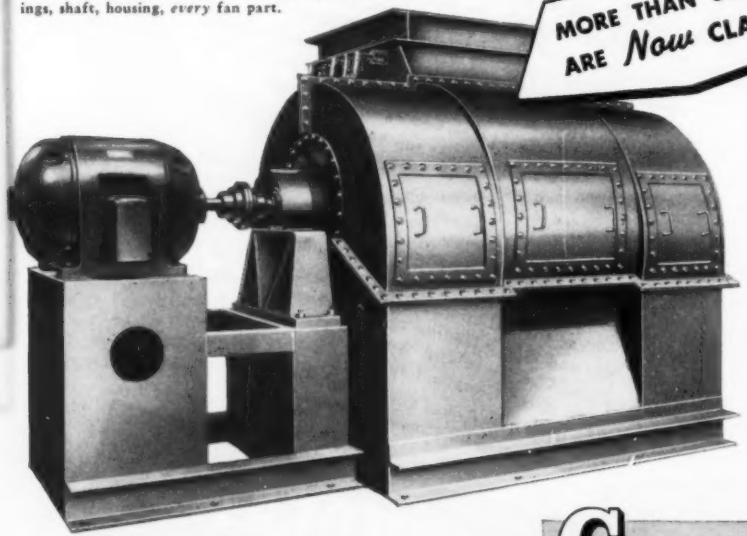


**This ad shows Clarage Type RT Fans, especially designed and built for *tough* air handling services — large volumes (up to 300,000 c.f.m.), high static pressures, high temperature applications.**

Induced draft is one of the services to which this Clarage equipment is *particularly* adapted. The Type RT Fan at right is arranged for induced draft fan work. It is equipped with inlet box, insulation clips and water-cooled bearings which permit the handling of extremely high temperature gases with long-lasting performance.

Type RT Fan construction is HEAVY-DUTY — and that applies to wheel, bearings, shaft, housing, *every* fan part.

**MORE THAN 3000 POWER PLANTS ARE *Now* CLARAGE EQUIPPED**



The Type RT Fan at left is equipped with *fan*-cooled bearings. For medium high temperature work (industrial process air handling and some types of induced draft), *fan*-cooled bearings — *a Clarage development* — are practical and *less expensive* than water-cooled bearings.

All Type RT Fans operate at speeds suitable for direct drive from electric motors or steam turbines.

**DIRECT YOUR INQUIRY INTO CAPABLE HANDS**

Clarage equipment — from the smallest to largest fans — is built HEAVY-DUTY. Whatever your air-handling problems, we can provide satisfactory results at astonishingly low operating and maintenance costs. *Your inquiry is invited.*

**CLARAGE FAN COMPANY**
KALAMAZOO, MICHIGAN
APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

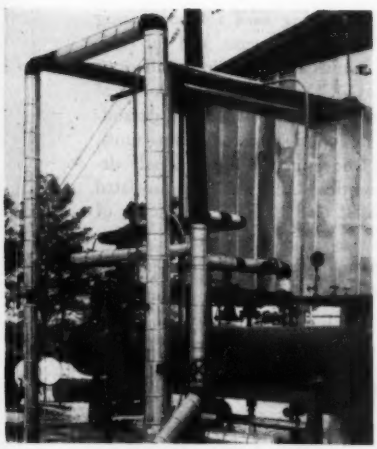
**CLARAGE**
**—HEADQUARTERS for Air Handling and Conditioning Equipment**

**IN PETROLEUM REFINERIES** like this a new kind of aluminum jacketing is used to protect the insulation on hot and cold lines. It is known as Childers Aluminum Jacketing and is especially engineered to combine the long life and weather resistance of aluminum with a low first cost. It goes on quick and easy—can be used and re-used. It is made of tough but flexible .006" 3S aluminum alloy, so it handles easily and requires no shop forming.

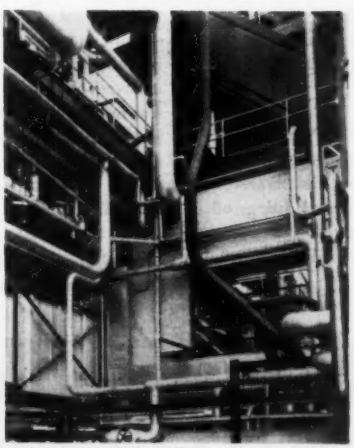
**IN CHEMICAL AND PAPER** plants: engineers are finding new uses for this easy-to-handle jacketing. Childers Jacketing here is in use at Scott Paper Company's tremendous Chester, Pa., plant. The insulated line passes between fast moving rolls carrying the felt used in paper making both above and below the line. The Aluminum Jacketing protects against paper dust and water, both of which are always present in the manufacture of paper. The jacketing also appreciably diminishes the possibility of the spread of fire which might strike across ordinary canvas jacketing.

# Engineered for outdoor lines — new, low-cost aluminum jacketing now used in 567 processing plants

The new kind of aluminum jacketing for insulated lines shown in the pictures on this page is Childers Aluminum Weatherproof Jacketing. Write for samples and full details, no obligation. Childers Manufacturing Co., Dept. PO-2, 625 Yale St., Houston 7, Texas.



**IN FOOD PROCESSING** plants such as this Minute Maid Corp. unit at Plymouth, Fla., Childers Jacketing is useful for both indoor and outdoor installations. Its clean, shining appearance and ease of washing are extra advantages.

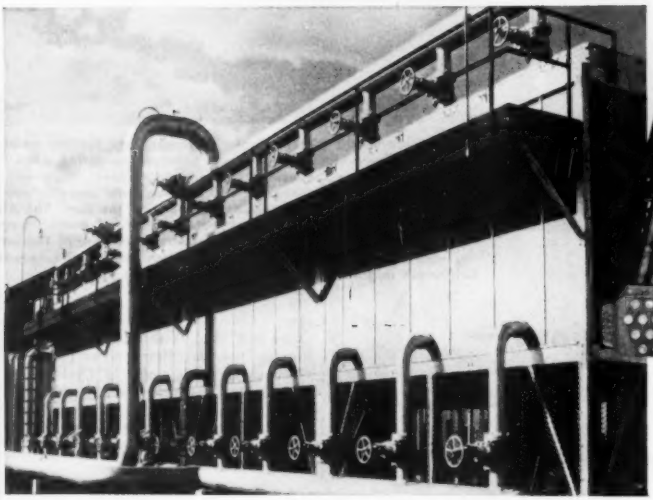


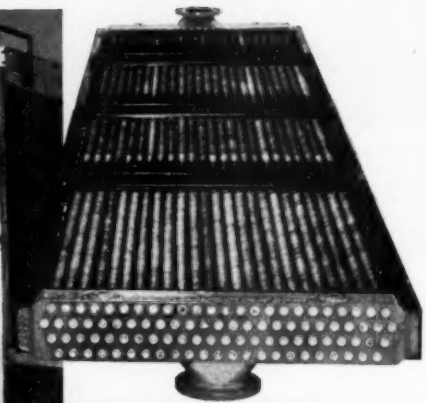
**IN POWER PLANTS**—indoors and out—Childers Jacketing is an ideal material for protecting insulation. This is a big outdoor installation in the South. This jacketing needs no painting, and the gleaming aluminum surface makes for "good housekeeping" in any utility or institutional power station.

**ALMOST ANYWHERE** you have insulated lines in your processing plant, consider this specially engineered jacketing. It is flexible, easy-to-handle; yet it has the appearance values and the weather resistance that are inherent in aluminum. Write to address shown above for full details.

*Advertisement*

# Now you can **condense steam** or **cool liquids** and **gases** by **AIR** in the **FIN-FAN EXCHANGER**





**Above: G-R K-Fin Air-Cooled Section as used in the Fin-Fan Exchanger. At left: Installation of Fin-Fan Exchangers embodying 12 K-Fin Air-Cooled Sections on top of the exchangers.**

At last! . . . a compact, effective, dependable, all-weather *air cooled* condenser and cooler that eliminates the complications, expenses and troubles of water cooling equipment.

The "package-type" self-contained FIN-FAN Exchanger comes to you as a complete unit, ready for erection. It is strongly designed for high pressures and temperatures, can be installed in limited space within a building, on the ground, or on a roof, and it operates with *forced draft*, independent of the direction or intensity of air currents.

This advantageous unit is being used for condensing exhaust steam and refrigeration systems, and for cooling oil, water, process liquids and gases in installations all over the country. Its G-R K-Fin elements with helical fins have proven their superior effectiveness and durability in many thousands of cooling and condensing units; and its fan, fan drive and structure are expressly designed by Fluor Corporation Ltd., who are associated with The Griscom-Russell Co. in the development of these units.

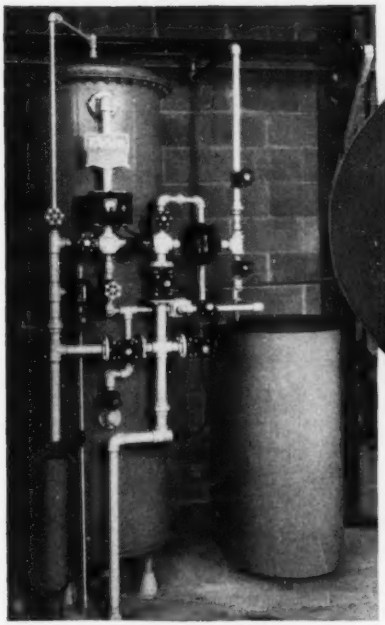
Write for Bulletin describing the Fin-Fan Exchanger in detail.

GR-210

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

**GRISCOM-RUSSELL**

PIONEERS IN HEAT TRANSFER APPARATUS



# ELGIN *ultra* DEIONIZER

Monoflo Design

★ ***Produces Highest Quality Mineral-Free Water***

★ ***Removes All Ionizable Impurities Including $CO_2$ and Silica***

**Replaces evaporation or distillation for as little as 1% to 10% of the cost**

## *Check these* Ultra-Deionizer Advantages

- Replaces evaporation or distillation for almost all purposes at a fraction of the cost.
- Assures ample makeup water at all times, whereas evaporator output varies with turbine load.
- Cuts operating cost because no heat is required and there is no power loss. No costly shut-downs for cleaning.
- Any required water quality assured by automatic electronic controls.
- Prevents corrosion in boilers, turbines and feedwater systems by eliminating $CO_2$—thereby cutting maintenance.
- Requires far less space than evaporator equipment. Lower investment cost.

Deionized water can be used in place of evaporated or distilled water for nearly every purpose, and at as little as a hundreth to a tenth of the cost. Of equal importance is the fact that the Elgin Ultra-DeIonizer gives the highest quality water known today — water free of all ionizable impurities, including $CO_2$ and silica.

This remarkable single tank, mixed-bed deionizer now brings the cost of high quality demineralized water within the range of those who have heretofore found evaporated or distilled water prohibitive in cost for processing and boiler feed. Here is the perfect boiler feedwater that assures freedom from scale, silica, corrosive $CO_2$, carry-over, and costly blowdown.

Naturally, since the Elgin Ultra DeIonizer is of compact single-tank design, it costs far less to buy and operate, and requires but little space. It is simple in operation. Like the notable Elgin Zeolite Water Softener, it is equipped with the ingenious "Double-Check" manifold assembly, well known for its ability to increase water output as much as 44% and to protect against loss of valuable resinous exchange material.

The Elgin representative near you will be pleased to give you complete facts and figures on this remarkable equipment which is available in sizes ranging from small units delivering 5 gpm to the largest size equipment required for central station steam plants.

***Get this bulletin*** Write for our NEW descriptive Bulletin 512 *which includes complete technical data.*

ELGIN Economical WATER CONDITIONING FOR EVERY NEED SINCE 1908

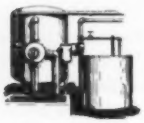
**ELGIN SOFTENER CORP., 130 N. Grove Ave., ELGIN, ILL.**

*Representatives in Principal Cities*

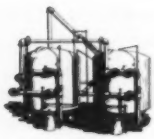
WATER CONDITIONING SINCE 1908

# Your Boilers... *need purer water than YOU do!*

HOT PROCESS SOFTENERS



ZEOLITE SOFTENERS



FILTERS

DEMINERALIZERS

REACTIVATORS

It may be hard to think of your own body as having a tougher constitution than your boiler plant. However, the water from wells and streams that can nourish your body may seriously damage your boiler plant.

Modern, high pressure plants can tolerate only minute amounts of hardness, alkalinity, silica, gases, and other dissolved impurities in their raw water supply. That's why it's so important to be *sure* of the *right* water-conditioning equipment for your particular water supply and your individual plant conditions.

You get this assurance with GRAVER equipment. GRAVER's 40 years of specialized experience, and the successful results of many thousands of GRAVER water conditioning installations all over the world provide authoritative recommendations, equipment selection and guarantees. GRAVER'S designs include equipment for *every* water conditioning process. And GRAVER's pioneering leadership offers you the most modern processes, equipment and materials of proven effectiveness, with many exclusive features.

**Write for bulletins and consultation . . . there's no obligation.**

GRAVER

**GRAVER WATER CONDITIONING CO.**

*Division of Graver Tank & Mfg. Co., Inc.*

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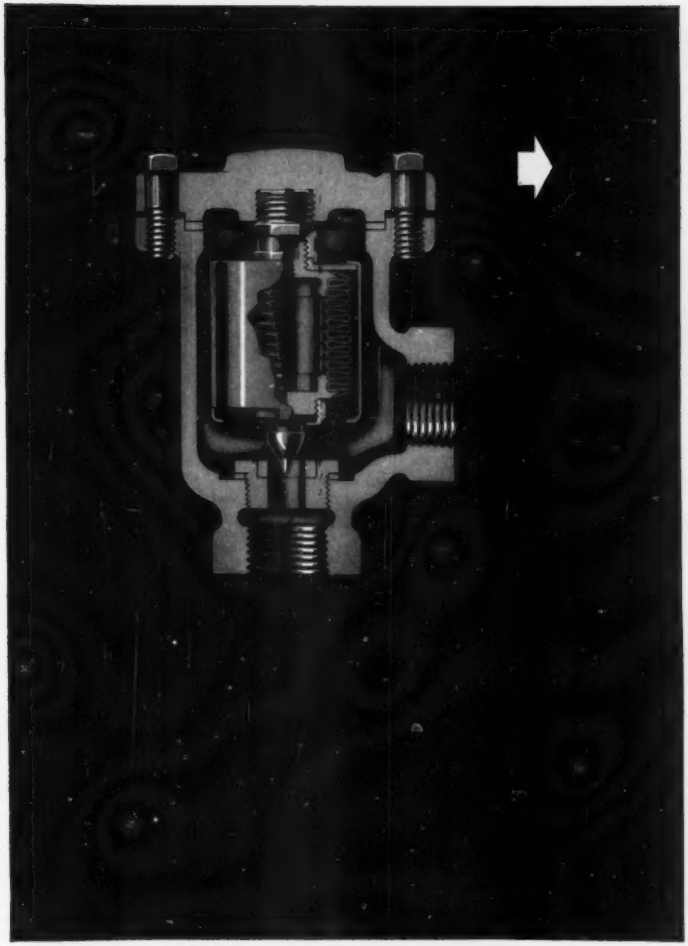
GW-490



**STEAM FOR HEAT...**

If you use steam for room or space heating or for any process, such as cooking, drying, evaporating or baking, you must necessarily use Steam Traps.

**WHAT KIND OF STEAM TRAP?...**

Of the many different types offered which should you choose?

**SARCO MAKES 4 TYPES...**

and can fit the trap to the job. We can give you unbiased advice, based on 30 years' field experience.

**GIVE US FULL DETAILS...**

on your trapping problem and let us pick the best type of steam trap for you, and tell you why.

**A MOST VERSATILE TYPE...**

is the Sarco balanced pressure thermostatic trap illustrated here.

It is suitable for most process steam applications and has many outstanding advantages.

**AMONG SPECIAL FEATURES ARE:...**

Only one moving part—the Sarco flexible bellows made of phosphor bronze, stainless steel or monel metal for maximum resistance to fatigue and corrosion.

No seats to change when pressures change—No protection required against freezing. Unequalled capacity for air removal.

## Highest Discharge Capacity Per Dollar Cost

364

*Write for New Bulletin No. 250-9*

**SARCO COMPANY, INC.**

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
SARCO CANADA LTD., TORONTO 8, ONTARIO
REPRESENTED IN PRINCIPAL CITIES

# Look here *first* when specifying expansion joints

Just "flexing" is not enough . . . it's Directed-Flexing Self-Equalizing — an exclusive Badger Mfg. Co. feature — that makes the real difference in expansion joint performance. The enlarged cross-section above shows the corrugated member in the unique *all-curve* pattern . . . no sharp bends or structure-weakening stresses . . . no danger of premature breakdown.

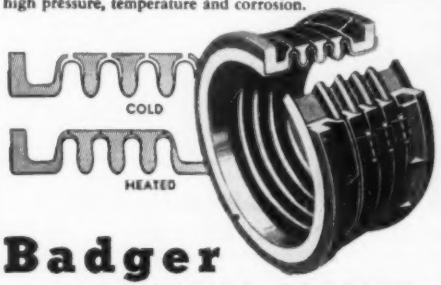
When combined with the correspondingly shaped Badger Self-Equalizing ring, a progressively controlled movement of each corrugation guarantees a more flexible longer lasting joint — a joint that succeeds where others fail. Get detailed information on the Badger Expansion Joint by writing today. Specify Badger Expansion Joints for every job.

**Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.**

*Plus 5 other big features*

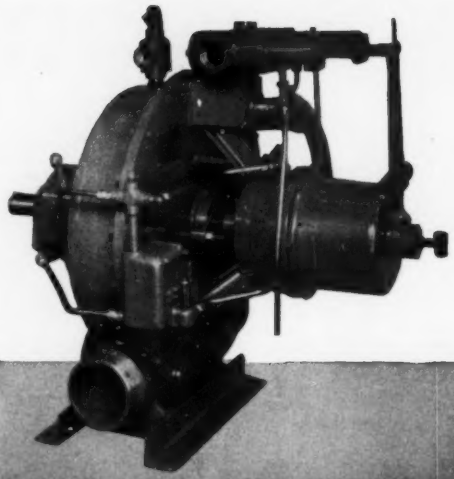
- Packless . . . pressure-tight single tube — requires no maintenance
- Compact . . . approximately the size of flanged fitting
- Special forming . . . no structure-weakening stresses
- Controlled heat treating . . . assures long life
- Wide range of traverse — pressure — temperature

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel alloys to withstand high pressure, temperature and corrosion.




**Badger**
MANUFACTURING COMPANY
230 BENT STREET, CAMBRIDGE, MASS.





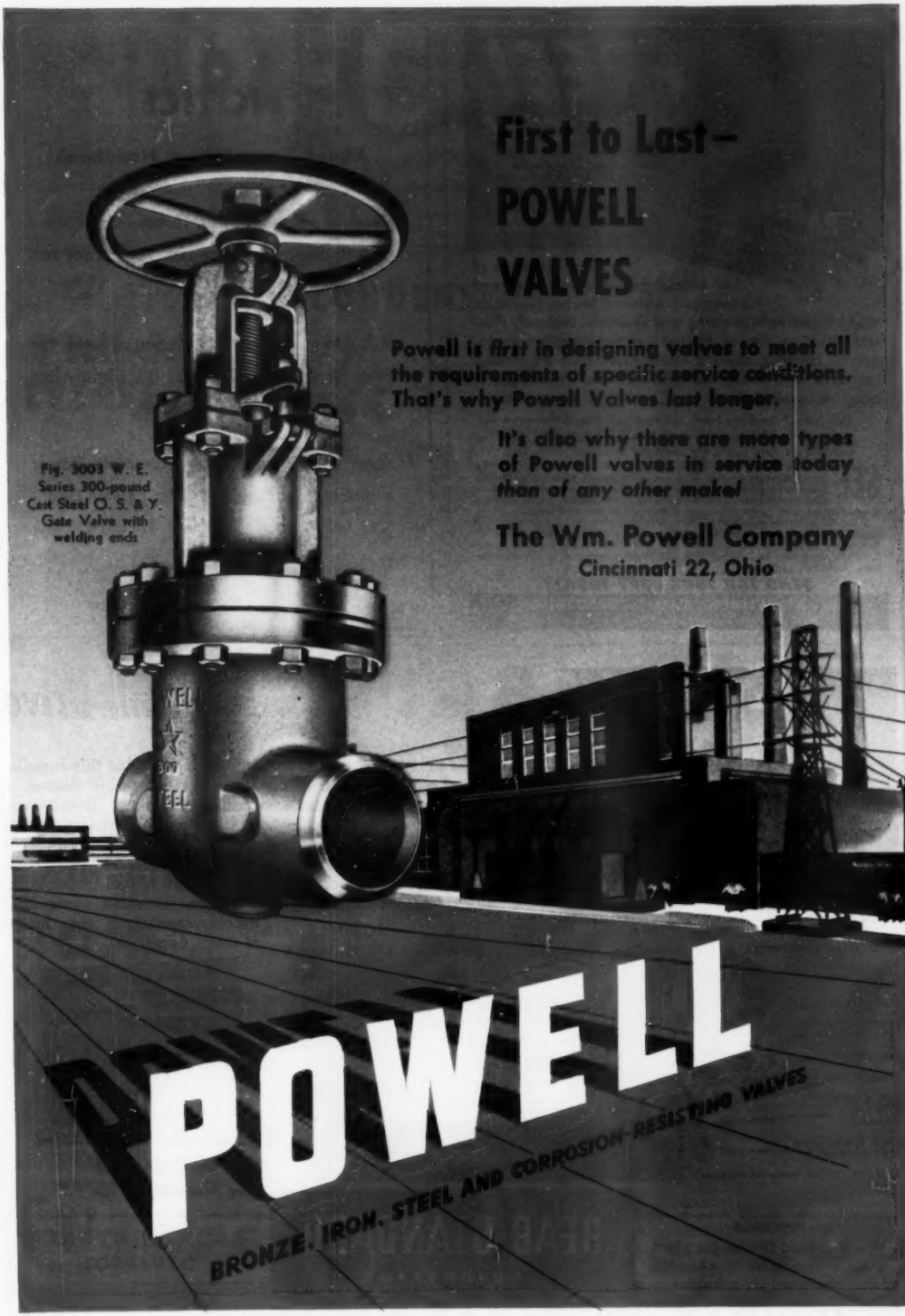
# Wing AUXILIARY TURBINES

WING TURBINES are especially economical for driving pumps, fans, compressors, etc., in plants using steam in process operations. The turbines act as reducing valves on boiler steam pressure, the power which drives the turbines, therefore, being practically free.

Wing Turbines for over half-a-century have been noted for their rugged construction, trouble-free operation and long life.

Maximum BHp 150. Maximum Steam Temperature 750°F. Maximum Pressure 600 lbs. Back Pressure to 50 lbs. Speeds to 4000 rpm.

**L. J. Wing Mfg. Co.**
**Linden, N. J.**
*Offices in principal cities*


First to Last–
POWELL
VALVES
Powell is *first* in designing valves to meet all the requirements of specific service conditions. That's why Powell Valves *last* longer.
It's also why there are more types of Powell valves in service today *than of any other make!*
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 3003 W. E. Series 300-pound Cast Steel O. S. & Y. Gate Valve with welding ends
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

this new WELDING DESIGN MANUAL

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Over 40 pages of helpful data covering basic and advanced welding techniques and designs used in fabricating and assembly. Profusely illustrated with scores of application drawings; weld diagrams; tables containing latest information on melting temperatures, tensile strengths, corrosion factors; charts; alloy recommendations; etc. Convenient digest size.

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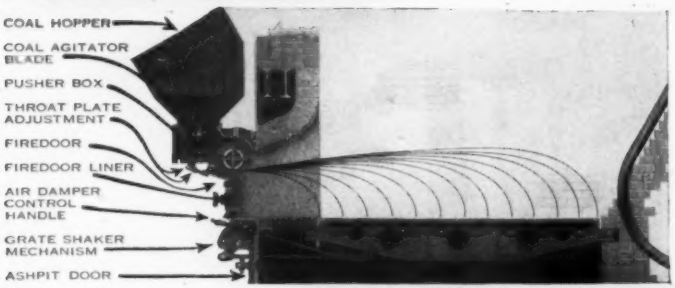
# 8 in LINE with *Unit-Drive*

WITH two spreader stokers on each boiler this installation of eight Chicago Automatics provides a high degree of operating flexibility and combustion efficiency. Distribution of fuel is accomplished by a rotating distributor of the underthrow type and an adjustable throat plate. All C-A's have this flexible and effective method of distribution together with instant action control over the movement of fuel through the stoker unit. Maximum protection is, therefore, assured in quickly meeting a wide range of steam demands.



*For complete information write Dept. F. 4 for Publication No. 85*

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# NOTES for the Power Engineer

C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

## *C. H. Wheeler* CONDENSERS are self-cleaning by REVERSE FLOW

## End Downtime for Cleaning Maintain Constant Full Load

Now you can end your troubles with clogged tube sheets. No longer need you shut down a steam condenser while a conglomerate of refuse—vegetable, animal and mineral—is laboriously removed by slow hand methods.

C. H. Wheeler has developed a simplified method for *reversing* the flow of cooling water in either single or divided water box condenser designs. Rapid reversal of cooling water flow effects a sudden change in temperature which shocks and dislodges marine growth. The physical force of the water flushes this and all other debris, including sand and muck, down the discharge.

The self-cleaning reverse flow is accomplished in new C. H. Wheeler condensers by built-in valves or sluice gates. A push button performs the flow-reversing operation. What formerly took hours is now accomplished in a matter of minutes with no interruption in load.

If you don't need a *new*, integrally built, Self-Cleaning Condenser, C. H. Wheeler can apply the Reverse-Flow principle to other steam condenser installations by means of external piping and four-way valves. Your correspondence is invited. C. H. Wheeler is "Ahead in Condenser Development."

### STEEL SHELL TUBEJET AIR EJECTORS MORE RELIABLE . . . SAVE SPACE

Engineers' fears of porous castings have led many to specify separate inter-after condensers with air ejectors. These fears are now totally dispelled with the new C. H. Wheeler Steel Shell Tubejet Air Ejectors. Designed originally to attain compactness for marine installations, thousands of these ejectors rendered outstanding service in World War II. This streamlined version of the older design effects considerable savings in space and weight. They are being widely adopted for stationary power plant use. Available with either single or multiple element, two-stage type with combined surface inter-after condenser. The coupon will bring you Specification 88, just released. It shows preferred method of piping to control hotwell level in main condenser.

### THIS NEW CATALOG WILL BRING YOUR CONDENSER INFORMATION UP-TO-DATE

**C. H. Wheeler Mfg. Co.,**
**1800 Sedgley Ave., Philadelphia 32, Pa.**

Name .....

Department .....

Company .....

Address .....

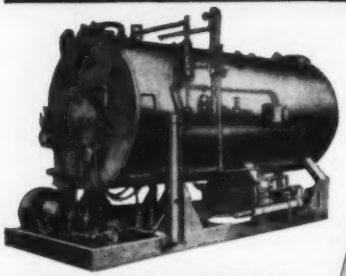
Please mail me file material on C. H. Wheeler

☐ Self-Cleaning Condensers ☐ Tubejets (Specification 88)

C. H. WHEELER MANUFACTURING CO., 1800 SEDGLEY AVE., PHILADELPHIA 32, PA.

*Advertisement*

# MODERNIZE with the AMESTEAM GENERATOR



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• COMPLETE • COMPACT
• ACCESSIBLE • EFFICIENT
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15 to 200 lbs.

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Manufactured under
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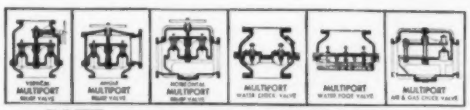
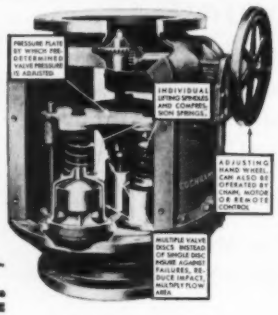



## THE SAFE, TIGHT, QUIET MULTIPORT RELIEF VALVE

### What Owners say about Cochrane MULTIPORT VALVES

"Twenty-five years of service. No other comment."
"Opened for inspection only once in 17 years."
"Opening and closing every 30 seconds with but little interruption for more than 12 years."
"This valve in service about 20 years with no maintenance."
"Savings cannot be computed. Absence of trouble is worth the price."
"No maintenance except change of springs for different pressure range after almost 15 years."
"No breakdown, no trouble, no expense."

**Over 15,000 Cochrane Multiport Valves in Service NOT ONE KNOWN FAILURE**


PRESSURE PLATE BY WHICH RELEASE DETERMINED VALVE PRESSURE IS ADJUSTED
INDIVIDUAL SPRING SPINDLES AND COMPRESSION SPRINGS
ADJUSTING HAND WHEEL CAN ALSO BE OPERATED BY CHAIN, MOTOR OR REMOTE CONTROL
MULTIPLE VALVE DISCS INSTEAD OF SINGLE DISC MOVE AGAINST FAILURES, REDUCE IMPACT, MULTIPLY FLOW AREA

Cochrane Corporation
3106 N. 17th Street, Philadelphia 32, Pa.

Please send me a copy of Cochrane Publication 4150 on Cochrane Multiport Valve.

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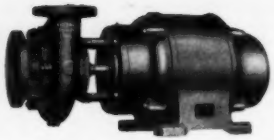
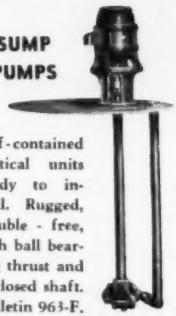


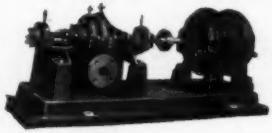
## CLOSE-COUPLED PUMPS

A real space-saving design with no sacrifice in durability and efficiency. For clear water, but can be had in special alloys. Bulletin 975-B.

## SUMP PUMPS



Self-contained vertical units ready to install. Rugged, trouble-free, with ball bearing thrust and enclosed shaft. Bulletin 963-F.

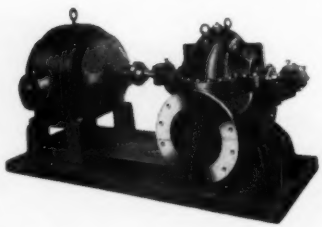


## TYPE "RR" PUMPS

For handling clear water, any temperature, at high pressures. Widely used for boiler feed. Rugged, efficient. Bulletin 980-B.

## DOUBLE SUCTION PUMPS

For top performance on clear water jobs, including air washers, these are of the finest materials and construction. Bulletin 955-N.



# "Buffalo" PUMPS

## MEAN MONEY SAVED THROUGH TROUBLE AVOIDED

True economy in pumping is in the pump you can install—and practically forget! "Buffalo" has always built such pumps. First cost may be a few dollars more than the "low-bidder" pump, but careful, sound "Buffalo" design and construction has always paid for itself in (1) longer years on the job, (2) fewer shutdowns, and (3) high efficiency.

As the pictures show, you can pick a "Buffalo" centrifugal pump that's tailor-made for your job. *WRITE FOR BULLETINS!*

## BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

*Branch offices in all Principal Cities*

**"... involving the world's largest and most intricate air conditioning project."**

The Kalamazoo, Michigan, Plant of the Upjohn Company
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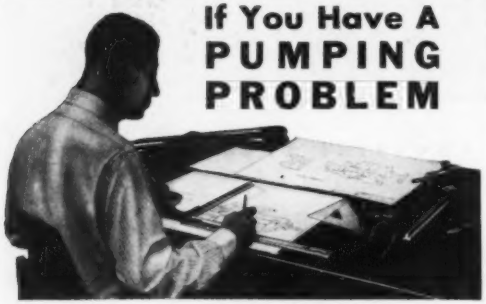

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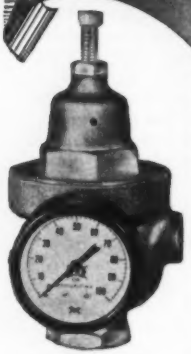

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# Not, PLEASE, In the Name of Fairness

**Our national Office of Economic Stabilization has adopted a policy of gearing wages to the cost of living.** We are told that "escalator clauses," which provide that rates of pay shall be adjusted to take account of changes in the cost of living, will be generally approved.

If the adoption of this policy had been announced as a frank concession to political expediency, it would have been quite understandable. There may very well be votes, lots of them, in a policy which purports to protect the income of a large group against loss through the price inflation caused by the defense program.

A case might even have been made for a policy of approving escalator clauses on grounds of production expediency. The leaders of some three million organized workers now covered by such clauses have indicated that they would fight to the limit to keep them and thus maintain "real wages," that is, wages measured by their purchasing power. The leaders of other organized groups have indicated they would fight to get the benefit of such clauses. Denial of them might mean serious strikes.

### Justified "in Fairness"

However, the policy of approving escalator clauses was not based on these relatively low grounds of expediency. It was justified on high moral grounds, on grounds of "fairness." In the words of the President's Council of Economic Advisers, "maintenance of real wages during inflation cannot in fairness be disallowed."

**That proposition is false.**

**It would be truthful to say, "maintenance of real wages during inflation cannot in fairness be allowed."**

The truth of the corrected proposition becomes evident immediately when you take a look at the basic nature of the inflationary problem created by defense mobilization.

We are devoting a large share of our national production to defense. The share is now scheduled to hit about 20% in 1952.

Since we are not able to increase our total production fast enough to meet defense needs

in addition to civilian needs, that means a cut in the supply of goods and services that is available for civilian consumption. But the money paid out for the production of defense materials is added to that which is available to buy civilian goods.

Thus, more money is put into the hands of the people to buy less goods. So prices go up. That is inflation.

If one group of people then is granted enough additional money to offset the price increases — and that is the purpose of an escalator clause — and thus can continue to buy as much as they have been buying right along, less goods will be left for other consumers who are not getting this advantage. That is palpably an unfair distribution of the sacrifices necessitated by defense mobilization. In fairness, therefore, maintenance of real wages in inflation cannot be allowed.

Organized workers were not the first, of course, to get the benefit of an automatic adjustment to take account of the increased cost of living. The farmers got theirs first. The price parity formula is, in essence, an escalator clause. The federal government underwrites increases in the prices of the things farmers sell in order to match increases in the prices of the things they buy.

### Crucifying the Helpless

**As matters stand, two groups are without benefit of escalator clauses.** One group is composed of manufacturing firms. While they have not been nearly as successful as the misleading reports of "record-breaking profits" suggest, they have been able to look after themselves fairly well — thus far.

But one group is completely without protection. It is that numerically large but politically unorganized mass of people — many of them old and relatively helpless — who are trying to live on pensions, annuities and other fixed incomes derived from their savings. They are at the end of the line when the increased costs of inflation are passed along. They have no one to whom they can pass the buck. They are being progressively pauperized by the continuing inflation caused by progressive boosting of costs and hence prices.

With the present line-up of pressure groups in Washington, protection for the principal victims of inflation — those who have saved for a rainy day only to find inflation has blown away the roof — is obviously an extremely difficult business. But to have even temporary insulation against inflation granted to powerful groups in the name of fairness should be offensive to the nostrils of a nation that presumes to assert the moral leadership of the Western World.

**The only really fair way to handle inflation is to prevent it. But once it is under way, fairness demands that the burdens be as evenly distributed as practicable.**

An escalator clause — or a farm parity provision — is explicitly a device to enable the group favored by it to escape the burden of inflation. Whatever concessions we feel we must make to political pressures or production expediency, let us at least be honest enough not to invoke "fairness" as justification for so arbitrary a discrimination in the distribution of the defense burden.

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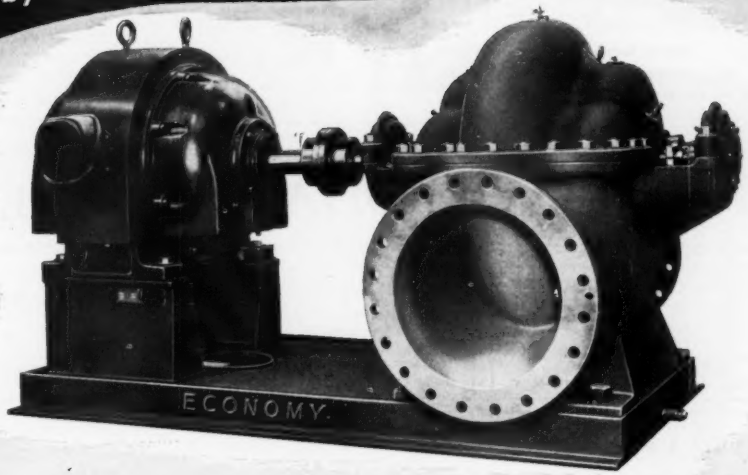


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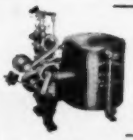

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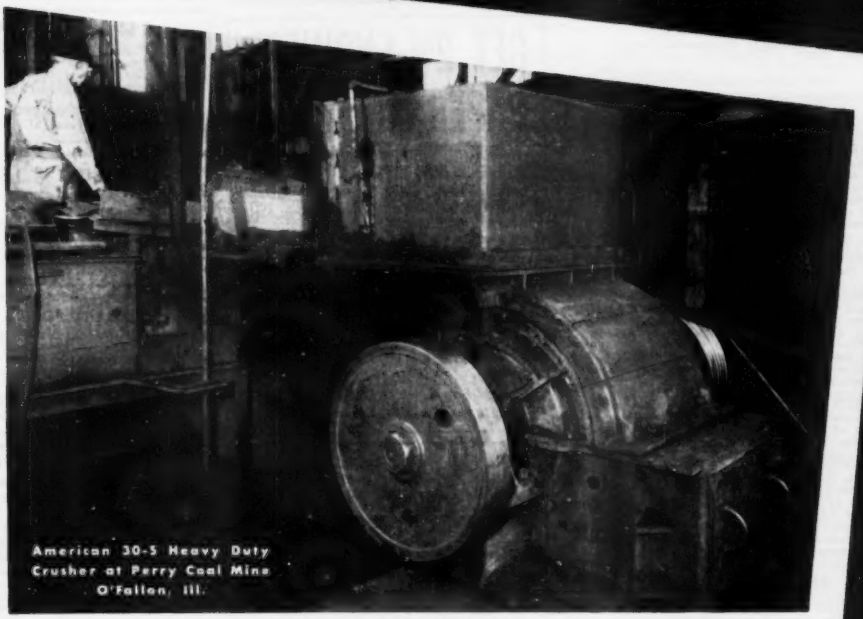
*(Taken From An Independent Survey)*



American 30-5 Heavy Duty Crusher at Perry Coal Mine O'Fallon, Ill.

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New 25 kw ac Diesel Generator 220-110 ac 60 c. Diesels 250—500—600—D17000—D12000 herman trailer. Boilers 300 H.P. 2 drum—500 H.P. sterling—Economic 100—150—250 H.P. HRT 60 by 20—78 by 30. Air compressors 4000—3000—300—500 —Electric and diesel drive. Railroad 100 ton track scale. 8 transformers 37½ kva 7200—240 NEW. Cranes 5 ton 70 ft span—50 ton 70 ft span.

**H. A. WOODWORTH ENG. CO.**
611 Olive Main 1071 St. Louis, Mo.

## EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

**A A A IRON CO.**
Canton & Hawkins Sts., Dallas 1, Texas

## WANTED FOR CASH

**Electric Motors—Starters, Transformers—Oil & Air Brkrs. Wire—Cable—Wiring Materials.**

*Send Listings*

**ALLIED ELECTRIC & MACHINERY CO.**
1007 Falls Bldg., P. O. Box 1838
MEMPHIS 1, TENN.

## LEGAL NOTICE

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933 AND JULY 2, 1946 (Title 39, United States Code, Section 233)

Of Power published Monthly at New York, N. Y., for October 1, 1951.

1. The name and address of the publisher, editor, managing editor, and business manager is: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York 18, N. Y. Editor, P. W. Swain, 330 West 42nd St., New York 18, N. Y. Managing editor, L. N. Rowley, 330 West 42nd St., New York 18, N. Y. Business manager, Shelton Fisher, 330 West 42nd St., New York 18, N. Y.

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4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

McGRAW-HILL PUBLISHING COMPANY, INC.
By J. A. GERARDI, Vice Pres. & Treas.

Sworn to and subscribed before me this 6th day of September, 1951.

[SEAL] ELVA G. MASLIN
(My commission expires March 30, 1952)

## HELP WANTED

*We have openings for:*

1. Resident Engineer on a large paper mill expansion in the south. Must know pulp and paper mills.
2. Structural, mechanical and process and electrical engineers, designers and draftsmen for power plant and paper mill work, location, southern Michigan.

Excellent salaries. Write immediately to

**P-1731, POWER**
**520 N. Michigan Avenue**
**Chicago 11, Illinois**

giving educational and experience record and personal data.

## POWER SUPERINTENDENT WANTED

for large paper mill power plant located in the South. Must be experienced with high pressure boilers and process steam operations. In first letter give college background, experience, marital status, etc.

**Write P.O. BOX 1844**
**SAVANNAH, GEORGIA**

## Mechanical Engineer

**STEAM POWER**

Ten years' experience in the design and installation of steam power plants in the industrial or utility fields. Submit full details regarding education, age, experience and salary required.

**THE BARRETT DIVISION**
**Allied Chemical & Dye Corporation**
**40 Rector St., N.Y.C., Personnel Dept.**

## SUPERINTENDENT

—for modern new high pressure 70,000 KW steam electric generating station in South Central United States. Must be graduate Mechanical Engineer with adequate experience and qualifications to immediately assume complete supervision of plant operation and maintenance. Good working conditions and ample opportunity for advancement due to continuing expansion of generating capacity. Preferred age 35 to 45.

*Please supply pertinent data in letter to:*

**P-2054, POWER**
**520 N. Michigan Ave., Chicago 11, Ill.**

## POWER PLANT ENGINEER

**For Large Eastern Utility**

Outstanding opportunity for mechanical engineer about 35 with practical experience in steam turbine power plant operation including technical ability to handle mechanical, steam and heat transfer matters incidental to design and operation of power plant equipment.

*Send full details*

**J. T. JENNINGS**
**241 ORANGE STREET**
**NEW HAVEN 10, CONN. (Agency)**

## ENGINEERS

**Chemical • Mechanical • Piping • Process**

Long term openings in permanent offices located at Cleveland, Ohio and Frederick, Maryland offering good salary plus overtime (forty eight hour week) for qualified Engineers, Group Leaders and Designers experienced in one or more of the following phases of Industrial plant design:

**Process Piping**
**Instrumentation**
**Process Equipment Layout**
**Packaging**
**Air Conditioning**
**Plumbing**
**Tanks and Vessels**
**Boiler Houses**
**Plant Layout**
**Conveyors**
**Heating and Ventilation**
**Refrigeration**
**Sprinklers**
**Water Treatment**

Limited number of openings for Estimators experienced in Mechanical and Chemical installations as well as building construction.

Also have a number of openings in our Cincinnati and New York City offices for similar type personnel.

Excellent working conditions with paid vacations, sick leave plan and participating Group Insurance Program.

Please submit complete resume stating experience, education, salary required and date available to:

**THE H. K. FERGUSON COMPANY**
***Engineers and Builders***
**FERGUSON BUILDING** **CLEVELAND 14, OHIO**

## GRADUATE ELECTRICAL ENGINEER

—to plan and supervise electrical plant betterment and maintenance in new high pressure steam electric generating stations. Desired to have three or more years experience in electrical design, construction, or maintenance of modern high pressure steam electric generating stations. Ample opportunity for advancement due to continuing program of plant expansion. Preferred age 30 to 45.

*Please supply pertinent data to:*

**P-2057, POWER**
**520 N. Michigan Ave., Chicago 11, Ill.**

## WANTED POWER PLANT SUPERINTENDENT

For 15,000 KW Modern Steam generating station equipped for firing with pulverized coal or oil. Desire Mechanical Engineer with several years experience. In reply give age, experience, education, etc. *Write*

**CITY WATER & LIGHT DEPT.**
**Thomasville, Georgia**

**WANTED:** Experienced Power Station Engineer.
**POSITION:** Assistant to Manager of Power Production with administrative responsibility of operating central stations totaling approximately 800,000 kw.
**LOCATION:** Pennsylvania.
**ADVANCEMENT:** Excellent for growth on job and promotion in near future.
**EXPERIENCE:** 10 years minimum, with at least 5 years in operation, maintenance or efficiency work in large modern steam-electric central station. Construction and design experience will be considered.
**EDUCATION:** B.S. degree in Mechanical (preferred) or Electrical Engineering from an accredited engineering college.
**AGE:** 30-45.

Salary commensurate with qualifications.
All applications will be acknowledged.
Please send personal record to
**P-2126, POWER**
**330 W. 42 St., New York 18, N. Y.**

**ADDITIONAL**
**POSITION VACANT ADS**
**ON THE OPPOSITE PAGE**

## *Wanted*

## ENGINEERS AND SCIENTISTS

**Unusual opportunities for outstanding and experienced men.**

These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.

**Immediate positions include:**

- Electronic project engineers
- Electronic instrumentation engineers
- Radar engineers
- Flight test engineers
- Stress engineers
- Aero- and thermodynamicists
- Servo-mechanists
- Power plant installation designers
- Structural designers
- Electro-mechanical designers
- Electrical installation designers

*Excellent location in Southern California. Generous allowance for travel expenses.*

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering.

**NORTHROP AIRCRAFT, INC.**
**1011 E. Broadway**
Hawthorne (Los Angeles County), California

## GRADUATE MECHANICAL ENGINEER

—to plan and supervise mechanical plant betterment and maintenance in new high pressure steam electric generating stations in South Central United States. Desired to have three or more years experience in design, construction, or maintenance of modern high pressure steam electric generating plants. Ample opportunity for advancement due to continuing program of plant expansion. Preferred age 30 to 45.

*Please supply pertinent data to:*

**P-2059, POWER**
**520 N. Michigan Ave., Chicago 11, Ill.**

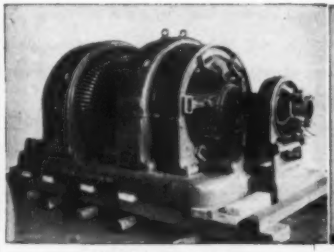
# IT ISN'T RE-NU-BILT UNLESS

## It Comes from

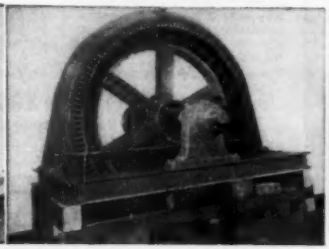
# BELYEA

## "SUCCESSFUL OPERATION GUARANTEED"

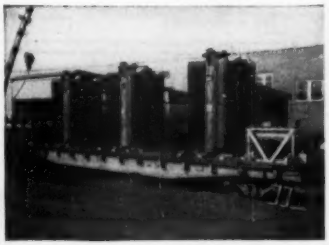
### RECENT SHIPMENTS



1000 KW MG SET



1000 HP 189.5 RPM SYNCHRONOUS MOTOR



3—667 KVA TRANSFORMERS

## MOTOR GENERATOR SETS

### 3 ph. 60 cycle

| Qu. | KW | Make | Speed | D.C. Volts | A.C. Volts |
|---|---|---|---|---|---|
| 2 | 2000* | G.E. | 500 | | 4600/11000 |
| 1 | 1500 | G.E. | 720 | 600 | 4600/13200 |
| 1 | 1500 | Whse. | 600 | 600 | 2300/4600 |
| 1 | 1500 | G.E. | 360 | 275 | 2200/4400 |
| 1 | 1000 | G.E. | 900 | 260 | 6600 |
| 1 | 1000 | Whse. | 900 | 600 | 2300/4150 |
| 1 | 1000(3U) | G.E. | 900 | 250 | 2400/4800 |
| 1 | 750 | Whse. | 900 | 250 | 2300 |
| 1 | 500 | G.E. | 900 | 600 | 4150 |
| 2 | 500 | Whse. | 900 | 250 | 6600/13200 |
| 1 | 500 | Whse. | 1200 | 125/250 | 2300 |
| 1 | 500 | G.E. | 720 | 125 | 2300/4000 |
| 1 | 400 | G.E. | 720 | 250 | 440/2300 |
| 1 | 400 | Whse. | 1200 | 250 | 2300 |
| 1 | 400 | G.E. | 900 | 275 | 2300/4150 |
| 1 | 350 | G.E. | 900 | 125 | 2300/4150 |
| 1 | 240 | G.E. | 1200 | 250 | 2300 |
| 1 | 300 | A.C. | 1200 | 240 | 2300 |
| 1 | 150 | G.E. | 1200 | 250 | 2300 |
| 1 | 150 | Whse. | 1200 | 275 | 2300 |
| 1 | 150 | G.E. | 1175 | 125 | 440 |
| 1 | 140(3U) | Cr. Wh. | 690 | 125/250 | 2300 |
| 1 | 100 | G.E. | 1170 | 125 | 220 |
| 1 | 100 | Delco | 1200 | 125/250 | 440 |
| 1 | 75 | G.E. | 1200 | 125 | 4000 |
| 1 | 75 | G.E. | 1200 | 250 | 440 |
| 6 | 70 | G.E. | 1200 | 70 | 220/440 |

*25 Cycle

## ROTARY CONVERTERS

### 60 Cycles

| Qu. | KW | Make | Speed | D.C. Volts | A.C. Volts |
|---|---|---|---|---|---|
| 1 | 2000 | G.E. | 514 | 600 | 13800 |
| 1 | 1000 | Whse. | 900 | 600 | 11000 |

## TURBO GENERATORS

| Qu. | KW | Make | Desc. |
|---|---|---|---|
| 1 | 6000 | Al. Ch. | Condensing 200/350 ISP 2300/2/60-Exc. & Surface Cond. |
| 1 | 2500 | G.E. | Auto. Ext. Cond. 800 lbs.-800° F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond. |
| 2 | 1000 | G.E. | Non-condensing, 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60. |
| 2 | 750 | G.E. | Condensing 425# -725°TT ISP-440 V-3 ph. 60 cy. New — 1944 |
| 1 | 625 | Whse. | Non-condensing, 125/150# ISP 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter |
| 2 | 500 | G.E. | Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60. |
| 1 | 400 | Whse. | Non-condensing 125/150# ISP 5/10# G.B.P. 240/480v. 3 ph. 60 cy. |
| 1 | 300 | G.E. | Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy. |
| 1 | 300 | Al. Ch. | Condensing 425# ISP Geared to 1200 RPM 120/240V. D.C. |
| 1 | 200 | Whse. | Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy. |

## D. C. MOTORS

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 1—2200 | G.E. | MCF | 600 | 360/500 |
| 1—1750 | West. | | 600 | 525/720 |
| 1—1500 | Whse. | | 525 | 400 |
| 1— 940 | Whse. | QM-R. Brg. | 250 | 140/170 |
| 1— 800/1000 | Whse. | | 450 | 600/720 |
| 1— 600 | Al. Ch. | MILL | 230 | 400/800 |
| 2— 450 | Whse. | | 550 | 415 |
| 1— 300/400 | G.E. | DYNA | 550 | 1325/2500 |
| 1— 350 | Cr. Wh. | CCM-151H | 230 | 1100 |
| 1— 335 | Whse. | MQ | 250 | 300/900 |
| 1— 200/300 | G.E. | MPC | 230 | 360/920 |
| 1— 250 | G.E. | MPC | 230 | 400/500 |
| 1— 150 | G.E. | | 600 | 250/750 |
| 10— 150 | Cr. Wh. | 82H | 230 | 690 |
| 1— 150 | Cr. Wh. | CMC-65H | 230 | 1150 |
| 1— 150 | Whse. | SK-201 | 230 | 360/950 |
| 1— 50/120 | G.E. | MFC | 230 | 250/1000 |
| 4— 75 | G.E. | TLC-59 | 230 | 850/2500 |

## FREQUENCY CHANGERS

| Qu. | KW | Make | Cycles | Voltage |
|---|---|---|---|---|
| 1—3000 | | G.E. | 25/60 | 4000/2300x2300/4000 |
| 1—1000 | | A.C. | 25/62½ | 2300/2300 |
| 1—1000 | | G.E. | 25/58 | 4400/2300 |
| 1— 500 | | A.C. | 25/60 | 11000/2300V |

## SYNCHRONOUS CONDENSERS

| Qu. | Kva. | Make | Volts | Speed |
|---|---|---|---|---|
| 1 | 5000 | Whse. | 4150 | 600 |

## TRANSFORMERS

### 60 Cycles

| Qu. | KVA | Make | Type | Ph. | Voltages |
|---|---|---|---|---|---|
| 2 | 4000 | G.E. | HF | 3 | 22000x2300 |
| 2 | 1500 | Pitts. | OISC | 1 | 22000x2300 |
| 3 | 1250 | G.E. | H | 1 | 6600x500 |
| 1 | 500 | Whse. | OISC | 1 | 34650x432 |
| 1 | 500 | Whse. | OISC | 3 | 13400x216 |
| 6 | 300 | G.E. | HT | 3 | 13200x240/480 |
| 3 | 300 | G.E. | HT | 3 | 6900x240/480 |
| 9 | 300 | G.E. | HT | 3 | 2400x240/480 |
| 3 | 150 | Pitts. | OISC | 1 | 480x240/120 |
| 3 | 100 | G.E. | OISC | 1 | 2400x120/240 |
| 3 | 75 | Pitts. | OISC | 1 | 480x120/240 |

## RECTIFIERS

| | | | | | |
|---|---|---|---|---|---|
| 1— 750 | G.E. | BHW | 575 | 2300 |
| 1—1000 | A.C. | B-612 | 625 | 13500 |
| 1—1000* | A.B.B. | GRZ | 625 | 6600/13200 |

*This unit with full automatic control good for both 25 and 60 cycle.

## A. C. MOTORS

### 3 ph. 60 cycle

#### SYNCHRONOUS

| HP | Make | Type | Volts | Speed |
|---|---|---|---|---|
| 2—6500 | G.E. | TS | 2300 | 257 |
| 2—2000 | Whse. | | 2300 | 120 |
| 2— 900 | Al. Ch. | (New) | 2200 | 150 |
| 3— 725 | G.E. | ATI | 2200/12000 | 600 |
| 1— 650 | Whse. | G | 2200 | 138 |
| 1— 500 | G.E. | TS 7857 | 2400/4800 | 600 |
| 1— 450 | Whse. | Eng. | 2200 | 128.5 |
| 2— 350 | G.E. | TS | 2200 | 150 |
| 1— 300 | Whse. | | 2300 | 720 |
| 1— 125 | G.E. | ATI | 440 | 450 |
| 1— 100 | Whse. | | 550 | 600 |

#### SLIP RING

| | | | | |
|---|---|---|---|---|
| 1—1000 | Whse. | CW | 2300 | 444 |
| 1— 500 | Whse. | CW | 550 | 550 |
| 2— 500 | G.E. unused | M-574Y | 2200 | 900 |
| 1— 500 | G.E. | IP | 550 | 505 |
| 1— 500 | G.E. | IM-MIII | 2200 | 450 |
| 1— 500 | G.E. | IM | 440 | 900 |
| 1— 350 | G.E. | MT442-Y | 2200/4000 | 257 |
| 1— 300 | Al. Ch. | 3 Brg. | 2300 | 505 |
| 1— 300 | G.E. | IM | 440 | 720 |
| 1— 300 | Al. Chal. | ANY | 2200 | 708 |
| 1— 250 | G.E. | MT-424Y | 4000 | 257 |
| 1— 250 | G.E. | MT-559S | 2200 | 1750 |
| 1— 200 | G.E. | MTP | 440 | 1170 |
| 1— 150 | new Whse. | CW | 2300 | 450 |
| 4— 125 | G.E. | MT-56-Y | 440/2200 | 435 |
| 4— 100 | G.E. | MT-556Y | 440/2200 | 425 |
| 1— 100 | G.E. | IM-16 | 2200 | 435 |
| 2— 100 | G.E. | IM | 440 | 600 |
| 3— 100 | Al. Ch. | ANY | 440 | 695 |
| 1— 100 | G.E. | MT556 | 2200 | 900 |
| 1— 75 | Whse. | CW-761 | 2200 | 1727 |

#### SQUIRREL CAGE

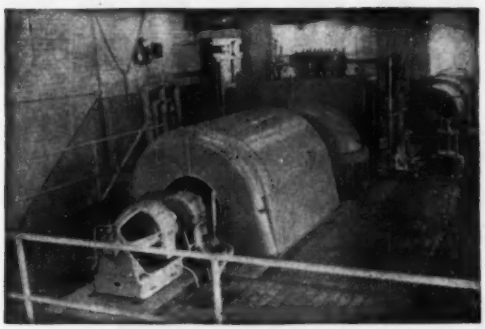
| | | | | |
|---|---|---|---|---|
| 2— 650 | G.E. | FT559BY | 440 | 3750 |
| 2— 450 | Whse. | CS | 2300/4150 | 354 |
| 1— 300 | G.E. | KT-574Y | 2200 | 505 |
| 1— 200 | G.E. | IK-17 | 440 | 580 |
| 1— 200 | G.E. | KT557 | 440 | 1800 |
| 1— 200 | G.E. | IK | 440 | 865 |
| 1— 150 | Wstghse. | CS856B | 440 | 880 |
| 1— 125 | Whse. | MS | 440 | 485 |
| 1— 125 | G.E. | KF-TEFC | 440 | 3585 |
| 2— 125 | Al. Ch. | ARW | 2200 | 1750 |
| 1— 100 | G.E. | IK-Vert. | 2300 | 450 |
| 2— 100 | G.E. | KT-513 | 220/440 | 1750 |
| 1— 100 | G.E. | KT-556 | 440 | 900 |

RE NU BILT BELYEA MOTORS

# BELYEA COMPANY, Inc.

43 HOWELL ST., JERSEY CITY, N. J.
PHONE—JOURNAL SQUARE 2-3334
N. Y. LINE—RECTOR 2-7150

# • TURBO GENERATORS •

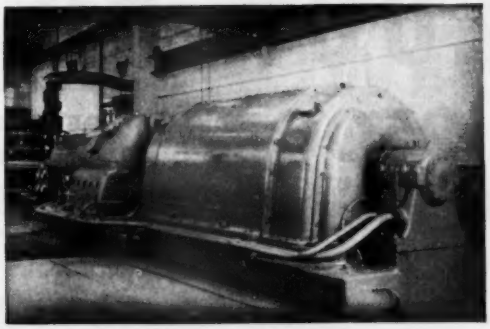


## Actual Photo—2500 KW

**GENERAL ELECTRIC TURBO UNIT**

**TURBO:** 2500 KW, 3600 r.p.m., Form AA, 11 stage, 800 lbs. ISP, 750° FTT, 200 lbs. G.
AUTOMATIC EXTRACTION, 2½" abs. condensing.
**GENERATOR:** 2500 KW, 3600 r.p.m., 3125 KVA, 80% p.f., type ATB-2 form T, 3 phase, 60 cycle, 2300 volt.
**EXCITER,** 25 KW, 125 volt, 3600 r.p.m. direct connected. Complete operating panel.
**CONDENSER:** Alberger, surface type, 2 pass, complete with circulating, condensate and air removal pumps.
**WATER RATES:** Calculated at 800 lbs. I.S.P., 750° F.T.T., and 2½" abs.—KW—Lbs. per KW Hr.

| | | | |
|---|---|---|---|
| 3125 KVA | 10.89 | 1875 KW | 11.22 |
| 2500 KW | 10.89 | 1250 KW | 11.92 |



## Actual Photo—6000 KW

**ALLIS CHALMERS TURBO UNIT**

**TURBO:** 6000 KW, 3600 r.p.m., 200/225 lbs. I.S.P., 550° F.T.T., 2½" abs., condensing.

**GENERATOR:** 6000 KW, 3600 r.p.m., 7500 KVA, 80% p.f., 3 phase, 60 cycle, 2300/4100 volts.

**EXCITER:** 50 KW TURBO UNIT, 125 volt complete operating panel.

**CONDENSER:** ALLIS-CHALMERS, Surface type, 2 pass, complete with circulating, condensate and air removal pumps.

This installation may be purchased in its entirety or in parts, and we will be pleased to supply additional information upon inquiry. The 2500 KW G.E. Electric Unit served as a topping installation for the 6000 KW Turbo Unit; and associated equipment included one

## • B & W STIRLING BOILER •

100,000 lbs. per. hr., 800 lbs. pressure, 800° F.T.T. complete with pumps, pulverizers, gauges, valves, and standard trim.

## Recently Acquired Geared D.C. Turbo Units

2—1000 KW—G.E.—Non-Condensing 200# ISP—100° S.H.—5/20# B.P. 480/3/60.

1—1000 KW—Moore-GE. Condensing Mixed Pressure—200# ISP—100° S.H. 250V. D.C.

2—500 KW—G.E. Non-Condensing 200# ISP—100° S.H. —5/10# B.P.—250V. D.C.

*Photo at left shows installation can be inspected as shown.*

# BELYEA COMPANY, INC.

**43 HOWELL STREET JERSEY CITY 6, N. J.**

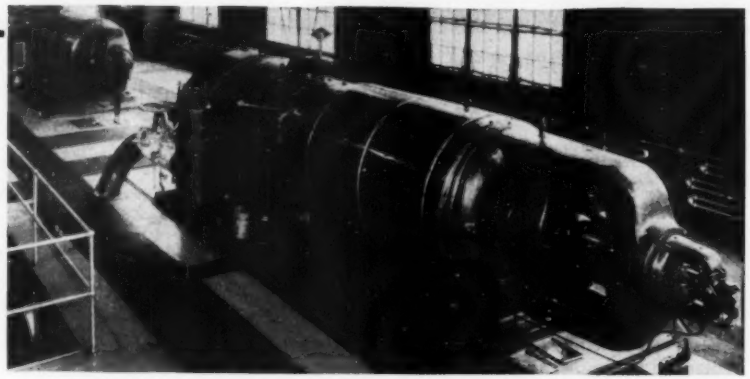
# LOOK NO FARTHER

**2500** KW. @ .80, 3125-KVA.

**TWO (2)** GENERAL ELECTRIC TURBO-GENERATORS

VERY HIGH GRADE UNITS : Are Duplicates

## WILL PASS RIGID INSPECTION



Above View shows our Two (2) General Electric Turbo-Generators on present Foundations. They are 2500 KW @ 80% PF, 3125 KVA, both are complete units with (2) Surface Condensers, Exciters, and all auxiliaries. Steam 160/225# psig, 450° FTT, 2300, 4160, 6900 V.

BULLETIN #900 in Colors has specifications and Complete Data on above Units. SEND FOR IT TODAY.

## A PARTIAL LIST OF TURBO-GENERATORS IN OUR STOCK IS GIVEN BELOW

12,500-KVA G.E., CONDENSING Complete A-1

6,250-KVA G.E., Complete Condensing Unit Condition: Excellent. 200# PSIG. 2300/4160 V High Grade Unit

3,750-KVA G.E. 150/250# PSIG, 480 Volt Limited use since Rebuilt A-1

3,750-KVA G.E. modern 440# PSIG, 750° FTT 2300 Volt. Rare unit.

3,125-KVA 160/225# psig, 2300 Volt
See above Cut and description (2)

3,125-KVA G.E. 200# psig, 2300 V. OK

2,500-KVA G.E. 150/200# psig, 2300 V

2,500-KVA, Westg. 250/350# psig, 2300 Volt, Non-cond. Like New Unit. Back P. 40/50#. Modern. Any Insp.

1,875-KVA Allis-C. 150-200# psig 2300 V. Rebuilt by Allis Co.

1,875-KVA Allis-C. 150/250# psig 2300 V. Very Good

1,250-KVA, Allis-C, 200# psig. Rebuilt Excellent condition A-1

937-KVA G.E., 150# psig, 480 V Rebuilt

1,000-KVA 440# psig, 750° FTT, Condg. New, never uncrated G.E. 480 V

937-KVA Allis-C. 125/200# psig 480 V. Rebuilt, New Coils No. 1

625-KVA, Westg. 250# psig, Non-cond. 125#, B.P. Like New Machine

625-KVA, G.E., 125/175# psig 480 V A-1

## ALL ABOVE TURBINES ARE IN STORAGE: IMMEDIATE DELIVERY

## COMPLETE DATA IS IN OUR FILES: INSPECTION REPORTS, DRAWINGS, ETC. ARE YOURS FOR THE ASKING

WRITE,
WIRE OR
TELEPHONE

**CHARLES WEAVER, Owner**
ELECTRICAL AND MECHANICAL ENGINEERS
4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

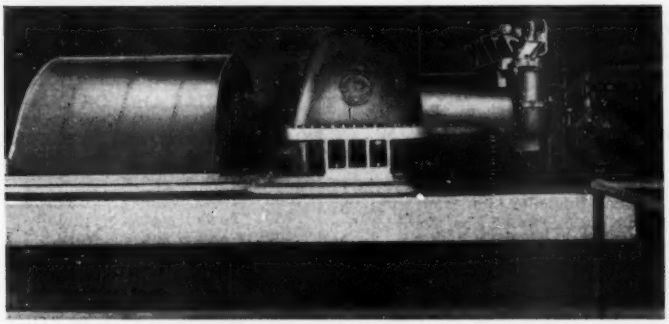
TELEPHONES:
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-6038

GOOD EQUIPMENT • RIGHT PRICES • IMMEDIATE DELIVERIES

# FOR TURBINE GENERATORS BOILERS, DIESEL POWER

## 3000 KW .80 3750-KVA. GENERAL ELECTRIC CONDENSING TURBO-GENERATOR

### A MODERN HIGH PRESSURE HIGH TEMPERATURE UNIT



The above Reproduced Photograph Covers a Very Modern General Electric, Form GG., 14-Stage, 3000 KW @ 80% PF, 3750 KVA. Turbine-Generator, a design very seldom on the market. It is a 400# psig, 750° FTT, 3/60/2300/4160 volt, condensing, in excellent condition in every way. Is served by a Surface Condenser and is a complete installation. FULL DATA ON REQUEST.

---

### OUR NOVEMBER SPECIALS

2,500-KVA, Westinghouse Non-Condensing Turbo-Generator. Steam 250/400# psig, 40# Back P, 50# BP with changes 3/60/2300-V. Limited Service: Modern. Like a New Unit. Ask for Inspection Report.

6,250-KVA, General Electric Condensing Turbo-Generator, A complete Machine with Surface Condenser and all appurtenances. Steam 200# psig, 600° FTT, 3/60/2300-4160 Volt. Condition: Ready for installation with no repairs. Send for inspection Report and Data. Deliver Duty Free any point in USA or Canada. Investigate.

---

### OFFERINGS FROM OUR STOCK ARE NOTED BELOW

BOILERS: B & W, 850# psig, 100,000# steam per hour. Combustion Engineering Co., 450# psig, 70,000# steam per hour. These Boilers are in excellent condition. Will pass rigid inspection. Immediate Delivery. Full data on request. Many other high grade Boilers available. Send us your specifications. Space does not permit listing them here.

TURBINE-GENERATORS: LARGE CAPACITIES: 25,000 KVA, G.E. 15,000 KVA, G.E., 12,500 KVA G.E. ALL condensing units, complete with all auxiliaries. We have complete data on file and will be pleased to forward it to any interested parties. Prompt investigation is suggested.

**INVESTIGATION IS INVITED ON ALL OF THE ABOVE. ALSO ON TURBINES LISTED ON THE OPPOSITE PAGE. ALL GOOD MACHINES.**

WRITE, WIRE OR TELEPHONE

**CHARLES WEAVER, Owner**
ELECTRICAL AND MECHANICAL ENGINEERS
4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

TELEPHONES:
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-8038

# There's more than 40% to 60% SAVINGS on

## SCHOONMAKER DEPENDABLE DIESEL POWER

## because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

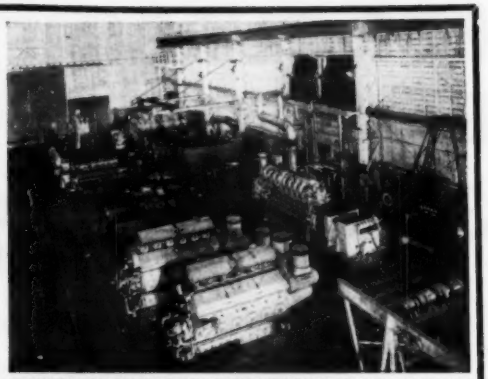
Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G.

SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.
PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

**A PARTIAL LIST OF OUR INVENTORY**

| KW | MAKE | MODEL | HP | RPM |
|---|---|---|---|---|
| 1500 | Fairbanks Morse | 33E16 | 2000 | 300 |
| 1230 | Nordberg | F6G168SC | 1750 | 327 |
| 1136 | Fairbanks Morse | 38D | 1600 | 720 |
| 1000 | General Motors | 16-278A | 1600 | 720 |
| 750 | General Motors | 12-567 | 1080 | 720 |
| 500 | Alco | 6-12-1/2x13T | 750 | 600 |
| 500 | Worthington | EE | 750 | 327 |
| 500 | General Motors | 8-567 | 720 | 720 |
| 340 | Baldwin | VO-6 | 510 | 450 |
| 320 | Buckeye | 80 | 480 | 600 |
| 300 | Enterprise | DSG-6 | 450 | 450 |
| 300 | General Motors | 8-268A | 450 | 1200 |
| 264 | Superior | KNA | 396 | 514 |
| 167 | Ingersoll-Rand | S | 255 | 600 |
| 160 | Buckeye | 80 | 240 | 600 |
| 100 | General Motors | 3-268A | 150 | 1200 |
| 100 | Worthington | BB-5 | 150 | 600 |
| 60 | General Motors | 6-71 | 90 | 1200 |
| 50 | Caterpillar | D-8800 | 76 | 1200 |

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

***Most all units still on foundation. Many may be seen operating***

**DIESEL UNITS**

1000 KVA Elliott-DeLaverne
594 KVA Elliott-Cooper Bessemer
375 KVA Fairbanks-Morse 32E14
250 KVA Fairbanks-Morse 32E14
250 KVA GE-Buckeye-E
187 KVA GE-Buckeye-E
175 KVA Fairbanks-Morse 32E14
125 KVA (2) Elliott-Buckeye
125 KVA GE-General Motors
90 KVA Fairbanks-Morse 32E14
75 KVA (2) General Motors
50 KVA (2) Fairbanks-Morse 42F
225 HP Buckeye (belted)
180 HP Fairbanks-Morse (belted)
120 HP (4) Caterpillar (belted)
120 HP Fairbanks-Morse 32E
120 HP Superior (belted)

**GAS ENGINE UNITS**

750 KVA Elec. Mchy.—800 HP Worthington Nat. Gas

**BOILERS**

427 HP Bigelow 3 dr. 200#
395 HP Union 3 dr. type L, 300#
370 HP Wicks Cr. drm. (2) 300#
333 HP Bigelow 3 drm. 250#
300 HP Combustion 3 dr. 160#
255 HP (2) Combustion 200#
230 HP (2) Vogt 3 dr. 160#
Three 250 HP HRT 150#
125 HP (2) Erie City Economic 150#

**TURBO GENERATOR UNITS**

3750 KVA Wghse. 3/60/600 v; bleeder
1250 KVA GE 3/60/480 v; bleeder
937 KVA Wghse. 3/60/480 v; bleeder
750 KVA Al.-Chal. 3/60/480 v; cond.
2000 KVA GE 3/60/2300 v; non-cond.
250 KVA GE 3/60/600 v; non-cond.
187 KVA GE 3/60/480 v; non-cond. 375#
SURFACE CONDENSOR 4000 Sq. Ft. Wghse.

**ENGINE-GENERATOR UNITS**
3/60/480/240 v.

312 KVA GE-Skinner unit.
250 KVA (3) Elec. Machy.—Skinner unit.
187 KVA Wghse.-Ames vertical
62 KVA GE-Ames Unit.

*Above listed units are only a few of our "SPECIALS." Advise your plant requirements.*

# POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

# BUY From L. J. LAND for

- Dependable Equipment
- Reliable Rebuilding
- 1 YEAR GUARANTEE
- REAL VALUES

**1 to 50 HP**
**NEW and REBUILT**
TEFC—EX. PR.—Drip proof and Splash proof—Geared Head
**IN STOCK**

## SQUIRREL CAGE MOTORS
### 3 phase

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 200 | Wagner | RP226F | 1800 |
| 200 | Al.Ch. (2) | BB | 880 |
| 200 | G.E. | KF-6335 | 880 |
| 150 | West. | CS | 580 |
| 100 | G.E. | IE-K | 1800 |
| 100 | G.E. | K-544 | 1175 |
| 75 | West. (2) | CS-654C | 1750 |
| 75 | G.E. | IK | 900 |
| 75 | G.E. | KT-352 | 865 |
| 75 | West. | CS | 720 |
| 60 | Howell | SCR | 1800 |
| 60 | West. (2) | CS-607 | 880 |
| 60 | Rel. | AA | 875 |
| 60 | G.E. | KT-346 | 865 |
| 60 | G.E. | TEFC(GH) | 427 |
| 50 | G.E. | FTR-523 | 3600 |
| 50 | Elliott | 196 | 3450 |
| 50 | G.E. (2) | KT | 1740 |
| 50 | G.E. | XP | 1750 |
| 50 | G.E. | KF-445 | 1170 |
| 50 | West (3) | CS | 870 |
| 50 | G.E. (2) | IK | 870 |

## SLIPRING MOTORS
### 3 Phase

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 600 | Cr. Wh. | 131AQ | 507 |
| 500 | G.E. (2) | IM | 450 |
| 500 | Ideal | | 1150 |
| 400 | West. | CW | 450 |
| 400 | G.E. | IM | 870 |
| 250 | G.E. | IM | 435 |
| 225 | Wagner | 25 cy. | 710 |
| 200 | G.E. | MT559Y | 1170 |
| 150 | Wagner | 31VRN | 900 |
| 150 | Burke | | 720 |
| 125 | West. | CW | 1750 |
| 125 | Burke | | 600 |
| 75 | West. | CW | 1150 |
| 75 | West. | CW | 720 |
| 75 | G.E. | MT556 | 900 |
| 75 | G.E. | IM | 690 |
| 60 | G.E. | MT533 | 1750 |
| 60 | West. | CW116 | 290 |
| 50 | G.E. | MT-536 | 1150 |
| 50 | Wagner | | 1150 |
| 50 | L.A. | OGH | 870 |
| 50 | Cr. Wh. | | 900 |
| 50 | G.E. | MT546 | 720 |
| 50 | G.E. | IM | 490 |

## SYNCHRONOUS MOTORS

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 475 | West. | | 720 |
| 300 | G.E. | ATI | 900 |
| 260 | G.E. | TS | 900 |
| 200 | West. (3) | | 900 |
| 180 | G.E. | ATI | 900 |
| 150 | G.E. | TS | 900 |
| 150 | G.E. | TS | 720 |
| 150 | G.E. | ATI | 900 |
| 100 | G.E. | ATI | 1200 |
| 75 | G.E. (2) | TS | 900 |
| 55 | El.Machry. | BRKT | 1200 |

## 230 V.D.C. MOTORS

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 200 | West. | SK210 | 575 |
| 150 | G.E. | L.C. | 1750 |
| 100 | Al.Ch. | | 1150 |
| 90/45 | G.E. | RF-17 | 950/475 |
| 75 | G.E. | RC36 | 800 |
| 75 | West (2) | SK-180 | 475 |
| 75 | Cr. Wh. | CMC | 375/950 |
| 60 | West. | SK-160 | 680 |
| 60 | West. | SK | 250/1000 |
| 50 | G.E. | CD | 3600 |
| 45/90 | G.E. | RF-17 | 475/1950 |
| 50 | West. (3) | SK-160 | 565 |
| 50 | G.E. | CD | 3600 |
| 50 | G.E. | RF-17 | 250/1000 |
| 40 | West. | SK-103 | 1750 |
| 40 | G.E. | RC-31 | 1700 |
| 40 | G.E. | CD-1441 | 400/1500 |
| 40 | Rel. | 461T | 400/1200 |
| 35 | West. | SK | 250/1000 |
| 35 | West. | SK-120 | 1150 |
| 35 | G.E. | RLC | 440/800 |
| 30 | West. | SK | 975 |
| 30 | Cont. | D-103 | 850 |
| 30 | G.E. | RC-33 | 775 |
| 30 | West. | SA | 500/1500 |
| 30 | West. | SK-143 | 575 |
| 25 | G.E. | RC-15 | 1750 |
| 25 | West. | SK-83 | 1750 |
| 25 | Rel. | 92T | 1150 |
| 25 | West. | SA | 500/1500 |
| 25 | West. (2) | SK-130 | 600 |
| 25 | G.E. | RF-14 | 300/1200 |
| 25 | West. | SK113 | 850 |

## 115 V.D.C. MOTORS

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 300 | West. | SK | 900 |
| 100 | Cr.Wh. | CCM | 900 |
| 40 | G.E. | DLC | 1150 |
| 40 | G.E. | RC | 1050 |
| 40 | G.E. | CD-113 | 850 |
| 30 | Eck. | | 950 |
| 25 | G.E. (2) | CD | 1800 |
| 25 | G.E. | CD93 | 1150 |
| 25 | Cr.Wh. | CCM | 750 |
| 25 | West. | SA | 600/1200 |
| 20 | G.E. | CD85 | 1150 |
| 15 | E.D. | 7½S | 650/1250 |
| 15 | Cr.Wh. | CM | 650 |
| 15 | Cr.Wh. | | 1800 |
| 15 | G.E. | RC | 1200 |
| 15 | Al.Ch. | | 900 |
| 10 | E.D. | 7½S | 425/1700 |

## 550 V.D.C. MOTORS

| HP | Make | Type | Speed |
|---|---|---|---|
| 765 | G.E. (3) | MPC | 1045/1350 |

## AC GENERATORS

| KW | Make | Speed |
|---|---|---|
| 180 | G.E. | ATB | 900 |
| 100 | G.E. | ATB | 360 |
| 15 | G.E. | ASI | 1200 |

## AC GENERATORS
### Driven by DC Motors

| KVA | Make | D.C. Input | A.C. Output |
|---|---|---|---|
| 62½ | G.E. | 230 | 240 |
| 50 | Star | 115 | 120 |
| 35 | G.E. | 230 | 220 |
| 31 | Ideal | 115 | 440 |
| 31 | Ely. Machry. | 230 | 440 |
| 18 | G.E. (8) | 230 | 120/240 |
| 10 | Burke | 115 | 120 |
| 7½ | Hertner | 115 | 440 |
| 6¼ | G.E. | 230 | 240 |
| 5 | El. Spec. | 115 | 110 |
| 1¼ | Al. Ch. | 230 | 110 |

## 600 V.D.C. GENERATORS

| KW | Make | Speed |
|---|---|---|
| 400 | G.E. (4) | 1200 |
| 325 | G.E. | 1200 |
| 30 | Burke | 1750 |
| 20 | Reliance | 1150 |

## GENERATORS
### 250 V.D.C. Motor Driven

| KW | Make | Speed |
|---|---|---|
| 300 | Elliott | 1200 |
| 250 | G.E. | 1150 |
| 200 | G.E. | 1200 |
| 150 | West. | 900 |
| 100 | Delco | 1200 |
| 100 | G.E. | 700 |
| 75 | G.E. | 1200 |
| 40 | Rel. | 1750 |
| 42 | ABC (2) | 1200 |
| 30 | G.E. | 1200 |
| 25 | G.E. | 1200 |

## 125 V.D.C. Motor Driven

| KW | Make | Speed |
|---|---|---|
| 225 | G.E. (2) | 1200 |
| 150 | West. (2) | 1200 |
| 100 | West. (2) | 900 |
| 100 | G.E. | 1200 |
| 100 | El. Machry. | 1200 |
| 100 | West. | 1200 |
| 50 | West. (2) | 1150 |
| 30 | G.E. | 1150 |
| 30 | L.A. | 1450 |
| 25 | El. Machry. | 1150 |

## GENERATORS
### Low Voltage D.C.

| Amp. | Make | Voltage |
|---|---|---|
| 10,000 | HVW | 2½/10 |
| 10,000 | North. | 2½/10 |
| 7,500 | HVW | 2½/10 |
| 2,500 | Chandeysson | 6/12 |
| 125 | Hobart | 7½ |
| 500 | Chandeysson | 12 |
| 1,500 | Century | 24 |
| 2,000 | G.E. | 24V |
| 150 | G.E. | 30 |
| 1,000 | G.E. | 33 |
| 150 | Watton | 40 |
| 1,000 | Chandeysson | 40 |
| 200 | G.E. | 42 |
| 1,500 | G.E. | 50 |
| 1,500 | Century | 60 |
| 1,500 | G.E. | 60 |
| 1,000 | G.E. | 75 |

## FREQUENCY CHANGERS AND GENERATORS

| Size | Make | Output Frequency |
|---|---|---|
| 150 KW | G.E. | 150 cy. |
| 154 KVA | G.E. | 150 cy. |
| 15 KW | G.E. | 408 cy. |
| 10 KW | G.E. | 200/700 cy. |
| 7½ KW | G.E. | 408 cy. |
| 3 KW | G.E. | 408 cy. |

## ELECTRIC HOISTS

1000# Y & T—D.C.
1000# Thor—Air.
1000# Y & T—A.C.
1000# Shepard—A.C.
2000# R & M—D.C. (3)
2000# C & M—D.C.
4000# Thor—Air
6000# R & M—A.C.

## GUARANTEE YOUR INVESTMENTS!

- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization —41 years' experience.

**Partial List ONLY**

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — NEW YORK 13, N. Y.

# ELECTRICAL EQUIPMENT

Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—

## REBUILT AND GUARANTEED

### PROMPT SHIPMENT — PARTIAL LISTING

**800/1600 AMPERE ARC WELDING MOTOR GENERATOR SETS**

Each set consists of two generators and one motor, mounted on base. Each Generator: Northwestern Type K20DR, 800 ampere, 50 volts, 1750 RPM. Motor: 125 HP, Allis Chalmers, Type AR, 2200 volts, 3 phase, 60 cycle, 1750 RPM.

**SLIP RING MOTORS—3 Ph., 60 Cy.**

| Qn. | HP | Speed | Volts | Make | Type |
|---|---|---|---|---|---|
| 6 | 7½ | 810 | 550 | G.E. | MTC-5201 |
| 2 | 10 | 1140 | 440 | West. | HF-17A |
| 2 | 10 | 570 | 220 | G.E. | HI-11 |
| 2 | 11‡ | 820 | 550 | G.E. | ITC-5008 |
| 2 | 15 | 1160 | 440 | West. | CW-404C |
| 2 | 15 | 570 | 220 | West. | CW-646 |
| 1 | 18 | 680 | 440 | West. | MW-316 |
| 1 | 20 | 860 | 440 | West. | CW-638 |
| 1 | 25 | 1130 | 550 | G.E. | MT-325 |
| 2 | 25 | 850 | 220 | Wagner | HR |
| 2 | 25 | 720 | 440 | Wagner | 22VBR |
| 1 | 30 | 865 | 440 | West. | CW-646 |
| 1 | 30 | 850 | 440 | G.E. | MT-332 |
| 1 | 30 | 675 | 440 | G.E. | MT-336 |
| 2 | 35 | 600 | 400 | F-M | HV-H16A |
| 2 | 40 | 865 | 2200 | Al. Ch. | ARY-223C |
| 1 | 40 | 560 | 440 | G.E. | MT-346 |
| 1 | 50 | 1150 | 440 | G.E. | MT-356 |
| 1 | 50 | 860 | 440 | West. | HF-12A |
| 1 | 50 | 570 | 440 | G.E. | MT-353 |
| 1 | 52‡ | 550 | 220 | G.E. | IQC-5012*** |
| 1 | 60 | 685 | 440 | West. | CW-758 |
| 1 | 60 | 570 | 550 | G.E. | MTC-5546 |
| 1 | 60 | 3465 | 550 | West. | CW-938 |
| 1 | 80‡ | 575 | 440 | G.E. | MTC-5352 |
| 2 | 125 | 430 | 440 | G.E. | IL-16 |
| 2 | 150 | 1750 | 440 | G.E. | MTP-549 |
| 1 | 175 | 585 | 550 | West. | CW-1002 |
| 1 | 200 | 495 | 2200 | G.E. | IM-17A |
| 1 | 250 | 600 | 2300† | G.E. | IM-17 |
| 3 | 300 | 900 | 440 | G.E. | IM-17 |
| 1 | 300 | 880 | 2200 | G.E. | IM-17A |
| 4 | 350 | 1775 | 2300 | G.E. | IM-E15A |
| 2 | 350 | 880 | 2200 | G.E. | IM-17A |
| 1 | 400 | 505 | 550 | West. | CW |
| 1 | 600 | 1770 | 440 | G.E. | IM-E15C |
| 1 | 772 | 735 | 4000‡‡ | West. | CW |

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. **2 phase. ***3 phase.
**New. †225 cycle.
*Also 440 or 2300 volts. †Also 440 or 550 volts.

**A.C. GENERATORS — NEW**

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

| Qn | KVA | RPM | Make | Volts |
|---|---|---|---|---|
| 3 | 18.7 | 1800 | Columbia | 240/120 |
| 6 | 18.7 | 1800 | Columbia | 208/120 |

**230 VOLT CONST. SPEED D.C. MOTORS**

| Qn. | Hp. | Speed | Make | Type |
|---|---|---|---|---|
| 10 | ½ | 850 | Reliance | T-25T |
| 25 | 3½ | 850 | West. | SK-30 |
| 1 | 7½ | 1150 | G.E. | CDM-66 |
| 3 | 7½ | 850 | G.E. | CD-75 |
| 10 | 10** | 1750 | Kimble | BA-324 |
| 5 | 10** | 1150 | Al. Ch. | ED-80 |
| 2 | 10 | 850 | West. | SK-83 |
| 10 | 13½** | 600 | West. | SK-93 |
| 3 | 15 | 1750 | G.E. | CD-75 |
| 5 | 15 | 825 | West. | SK-90 |
| 1 | 20 | 1750 | L.A. | ONA-L851 |
| 1 | 20** | 1450 | G.E. | CDM-83 |
| 1 | 20 | 1750/1310 | West. | SK-83 |
| 2 | 20 | 1150 | G.E. | RC-30 |
| 1 | 20 | 1450 | G.E. | CDM-83 |
| 11 | 20 | 750 | West. | SK-110L |
| 17 | 25 | 825 | West. | SK-120 |
| 1 | 30 | 1100 | G.E. | RC-12 |
| 1 | 40 | 1700 | West. | SK-103 |
| 1 | 40 | 750 | G.E. | RC-36 |
| 1 | 50 | 750 | West. | SK-150 |
| 1 | 50 | 850 | G.E. | RC-16 |
| 1 | 150 | 700 | Al. Ch. | |
| 2 | 200 | 1150 | G.E. | RC-38 |
| 1 | 250 | 1150 | C.W. | CMC-101A |

**230 VOLT ADJ. SPEED D.C. MOTORS**

| Qn. | Hp. | Speed | Make | Type |
|---|---|---|---|---|
| 6 | 5/7½ | 600/1800 | G.E. | RA-30 |
| 1 | 10 | 400/1600 | Reliance | T-92T |
| 1 | 12½ | 280/840 | West. | SK-130 |
| 1 | 15 | 600/1200 | West. | SK-100L |
| 1 | 20 | 540/1350 | G.E. | RF-11 |
| 1 | 20/25 | 300/1200 | West. | SK-153 |
| 1 | 25 | 400/1600 | G.E. | RF-18 |
| 1 | 25 | 500/1500 | G.E. | RF-12 |
| 1 | 25/29 | 400/1200 | G.E. | RF-13 |
| 1 | 30/40** | 400/1600 | G.E. | CD-1206 |
| 1 | 40/50 | 400/1200 | West. | SK-163 |
| 1 | 35 | 500/1500 | West. | SK-143 |
| 1 | 75 | 500/1500 | Cr. Wh. | CCM |
| 1 | 75 | 375/750 | Cr. Wh. | CMC-125H |
| 3 | 100 | 225/900 | G.E. | MPC-A |
| 5 | 100 | 400/1200 | Al. Ch. | |
| 1 | 100 | 220/900 | West. | SK-200 |
| 1 | 125 | 450/1000 | West. | SK-190 |
| 1 | 175 | 230/500 | West. | SK-220 |
| 1 | 375 | 350/500 | G.E. | MPC |

**New

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

**ELECTRIC GENERATOR & MOTOR CO.**

4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed

**SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.**

Totally Enclosed Fan Cooled, Ball Bearing

| Qn. | HP | RPM | Volts | Make | Type |
|---|---|---|---|---|---|
| 2 | 3 | 1160 | 440 | L.A. | JS-254 |
| 4 | 5 | 1730 | 440 | G.E. | K-254 |
| 3 | 7.5 | 1740 | 440 | G.E. | K-284 |
| 1 | 10 | 1725 | 440 | West. | CS-324 |
| 1 | 10 | 1165 | 440 | West. | CS-326-EXP |
| 1 | 10 | 1140 | 440 | Wagner | CP2-326 |
| 1 | 15 | 1175 | 440 | L.A. | JA-365 |
| 1 | 20 | 1760 | 220 | G.E. | K-364 |
| 1 | 25 | 1200 | 550 | G.E. | K-405 |
| 1 | 25 | 1170 | 220 | L.A. | JX-405 |
| 1 | 25 | 705 | 440 | West. | CS-W564 |
| 1 | 40 | 3565 | 440 | G.E. | KF-4058 |

**SPLASHPROOF, BALL BEARING**

| Qn. | HP | RPM | Volts | Make | Type |
|---|---|---|---|---|---|
| 1 | 3 | 1160 | 440 | L.A. | FS-254 |
| 23 | 5 | 1750 | 440 | L.A. | FS-254 |
| 1 | 5 | 1735 | 220 | G.E. | K-254 |
| 1 | 5 | 1160 | 440 | L.A. | FX-284 |
| 4 | 15 | 1150 | 440 | L.A. | FX-365 |
| 1 | 50 | 1760 | 440 | L.A. | FX-445A |
| 5 | 50 | 1160 | 220 | G.E. | K-504 |
| 1 | 150 | 1775 | 440 | L.A. | FX-1168 |
| 3 | 150 | 880 | 440 | L.A. | FX-1368 |
| 1 | 150 | 700 | 440 | G.E. | KF-6335 |

**OPEN TYPE MOTORS**

| Qu. | HP | Speed | Volts | Make | Type |
|---|---|---|---|---|---|
| 5 | 15** | 1735 | 440 | Century | SC326 |
| 1 | 15 | 1200 | 220 | G.E. | KT-502 |
| 1 | 15 | 900 | 220 | G.E. | FTR-512 |
| 1 | 20** | 3475 | 220 | West. | CS-356 |
| 5 | 20** | 1750 | 440 | Wagner | RPI-364 |
| 1 | 20 | 1750 | 220 | West. | CS-W364 |
| 1 | 20 | 1200 | 220 | G.E. | KT-512 |
| 2 | 20 | 1160 | 440 | West. | CS-4646C |
| 2 | 20 | 900 | 220 | G.E. | FTR-522 |
| 5 | 25** | 1740 | 440 | Century | SC-364 |
| 1 | 25 | 1160 | 440 | West. | CS-667C |
| 1 | 25 | 900 | 220 | Howell | SCRB-356*** |
| 1 | 25** | 875 | 440 | Master | PR-405 |
| 2 | 25 | 575 | 440 | G.E. | KT-542 |
| 3 | 30 | 850 | 550 | G.E. | K-2648 |
| 1 | 30 | 1755 | 220 | G.E. | FT-513 |
| 1 | 30 | 1160 | 440 | West. | CS644 |
| 1 | 30 | 870 | 220 | West. | CS646 |
| 1 | 40** | 3545 | 220 | G.E. | KF-4048 |
| 2 | 40 | 1750 | 440 | West. | CS-583C |
| 2 | 40 | 900 | 2300 | G.E. | FTR-536 |
| 4 | 50** | 1750 | 440 | Wagner | RP5-405 |
| 1 | 50 | 850 | 220 | West. | CCL |
| 2 | 60* | 1750 | 440 | Ideal | AH-444 |
| 2 | 60 | 900 | 440 | G.E. | KT-346 |
| 2 | 75 | 1160 | 440 | West. | CS-662C |
| 2 | 75 | 870 | 220 | West. | CS-766A |
| 2 | 75 | 865 | 2300 | G.E. | KT-352B |
| 1 | 100 | 690 | 220 | West. | C |
| 1 | 100 | 580 | 2200 | G.E. | IK-15A |
| 2 | 100 | 500 | 2200 | West. | CS-930 |
| 1 | 100 | 495 | 2200 | Al.Ch. | AN |
| 1 | 125 | 435 | 440 | Al.Ch. | AR |
| 2 | 125 | 400 | 2300 | G.E. | I-17-FR |
| 1 | 200 | 580 | 550‡‡ | G.E. | KT-5668 |
| 2 | 300 | 587 | 2200 | West. | CS-38A |
| 1 | 500 | 1200 | 110 | G.E. | KTP-567 |
| 1 | 700 | 1800 | 2300/4000 | West. | CS-4-39D12 |

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

**250 VOLT DYNAMOMETERS**

Cradle Type With Scale and Control

| Qn. | Make | HP | RPM | Type |
|---|---|---|---|---|
| 1 | G.E. | 150 | 2200/5000 | TL C-50 |
| 2 | West | 150 | 2200/5000 | SK-131 |
| 1 | GE | 200 | 1200 | C |

**MOTOR GENERATOR SETS**

125 and 250 Volts D.C.

(Write for complete Specifications)

| KW | Make | RPM | DC Volts | AC Volts |
|---|---|---|---|---|
| 3 | Cmi. | 1750 | 125 | 220/440 |
| 7.5** | West. | 1455 | 125 | 380/220‡ |
| 10 | West. | 1750 | 125 | 220/440 |
| 10 | West. | 1450 | 125 | 220/410† |
| 10 | West. | 1150 | 250 | 220/440 |
| 15** | G.E. | 1800 | 125 | 220/440 |
| 15 | G.E. | 1755 | 250 | 220/440 |
| 15 | West. | 1450 | 125 | 220/440‡ |
| 16 | West. | 1750 | 125 | 2200/440 |
| 25 | G.E. | 1200 | 125 | 220/440 |
| 30 | Al. Ch. | 1750 | 125 | 220/440 |
| 50 | G.E. | 1750 | 125 | 220/240† |
| 75 | G.E.* | 1200 | 125 | 220/240 |
| 100 | West. | 1160 | 125/250 | 2300/4100 |

Note: 3KW, 5KW & 7.5KW, 250V Sets Available.
**New. *Synch. Motor Driven. ‡50 Cy. †25 Cy.

**MOTOR GENERATORS**

1—750 KW Al-Ch Syn. 250 V. 720 RPM
1—300 KW G. E. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW G. E. Syn. 250 V. 1200 RPM
2—150 K G. E. Syn. 250 V. 1200 RPM
1—150 KW WEST Syn. 250 V. 1200 RPM

**ROTARY CONVERTERS**

1—500 KW G.E. Syn. 250 V. 1200 RPM
1—500 KW WEST. Syn 250 V. 1200 RPM
1—300 KW Al-Ch Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
2—150 KW G. E. Syn. 250 V. 1200 RPM
2—100 KW G.E. Syn. 250 V. 1200 RPM

**ARMATURES**

1—500 KW G.E. 250 V. Generator 900 RPM
1—300 KW G.E. 600 V. Converter 1200 RPM

**WALLACE E. KIRK COMPANY**
**502 Grant Bldg., Pittsburgh 19, Pa.**

**AMERICAN**
SINCE 1902
**COMPRESSORS**
**VACUUM PUMPS**
YOUR CHOICE:
American—Bury—Chicago—
Curtis—Davey—Gardner
Ingersoll—LeRoi—
Penn—Schramm—
Sullivan—Worthington
RENTAL
273 AIR COMPRESSORS AVAILABLE
RENTAL PURCHASE
GAS — DIESEL — ELECTRIC
**AMERICAN AIR COMPRESSOR CORP.**
Dell Ave., & 47th North Bergen, N. J.

**COMPLETE DIESEL PLANT**

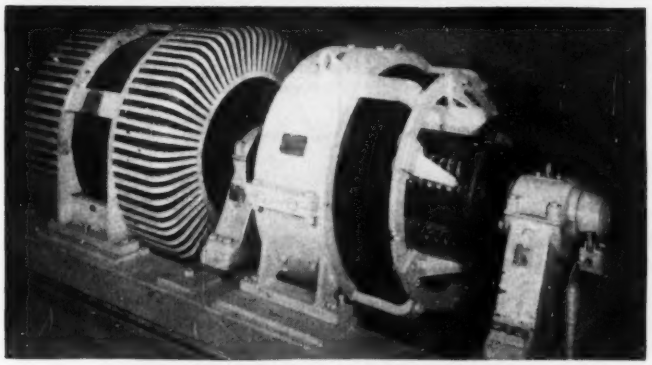
3—575 HP F.M. 5 cylinder, 400 RPM. 383 KW F.M. 3/60/2300 alternators. Woodward governors, heat exchangers and complete plant auxiliaries. For sale in whole or part. Condition excellent.

**MISSISSIPPI VALLEY EQUIPMENT CO.**
507 Locust St. St. Louis 1, Mo.

**FOR SALE**
**GENERAL ELECTRIC FREQUENCY CHANGER SET**

600 KVA, 3 phase, 120 cycles, 475 volts, type ATB-BL, frame 984Y, .65 PF, 1200 RPM, 1 bearing—with direct connected 5 KW, 125 volt exciter—connected to 800 HP, synchronous, 3 phase, 60 cycle, 550 volt, type TS, frame 9834, 1200 RPM, .8 PF, 2 bearing motor—with direct connected 5 KW, 125 volt exciter with G.E. starting reactor, type R-543 and panels for synchronous motor.

*Call*—MAIN 4-5900 • *Write*
**EMPIRE ELECTRIC CO., INC.**
87 Jay St. Brooklyn 1, N. Y.



*500 K.W. Westinghouse Motor Generator Set*

## MOTOR GENERATOR SETS

### Philadelphia Stock

1—1000 K.W. Westinghouse 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Motor .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels Modern Unit—Can furnish 60 cycle 2300 or 13200 volt.

1—600 KW G.E. MPC—2400 amp. 230 volt 514 RPM with 1050 H.P. G.E.—ATI Syn. Motor .8 P.F. 2 phase, 60 cycle, 2300 volt A.C. & D.C. Panels—Can furnish 3 ph. 550 V. or 2300 V.

2—500 KW Westinghoues 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/2300/13200 volt, Serial #8130447-48 (year 1935) See actual photo above.

1—500 K.W. Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.

1—300 K.W. West. 3 wire 125/250 Volt 1200 RPM Generators (1938 year). Can furnish with suitable motor as single unit or as 600 K.W. 3 Unit Set. Advise Requirement.

1—300 K.W. Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM—Automatic Controller & D.C. Panel.

2—150 K.W. G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.

1—100 K.W. Al. Chalmers 250 Volt 1200 RPM 150 H.P. Syn. Motor 2/60 or 3/60 any voltage.

1—100 K.W. G.E.—C.D.—125 Volt D.C. 150 H.P. GE Syn. Motor, 3/60/220/440/1200 RPM.

1—75 K.W. Burke 250 Volt, 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 phase, any voltage.

**Smaller Sizes and Types—Advise Requirements.**

## DIESEL GENERATORS

2—1250 KVA GM 3/60/2300/720 RPM complete Plants—Used 4 years.

1—1000 KVA Hamilton 99 DA 3/60/2300/4160 600 RPM—New 1943—Never used.

1—625 KVA Baldwin—Series 600 3/60/2300/514 RPM—New 1948—1500 hours.

1—225 KVA General Motors, Twin 671, 3/60/440. —New 1941.

## ELECTRIC MOTORS

| Q. | H.P. | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 1200 | Cr. Wh. | Sl. Rg. | 2300 | 257 |
| 1 | 700 | G.E. | ATI (syn) | 480 | 1200 |
| 2 | 600 | West. | Syn. | 440 | 257 |
| 3 | 500 | West. | CS | 6600 | 514 |
| 1 | 400 | G.E. | Syn. | 2300 | 450 |
| 1 | 400 | West. | CW | 440 | 514 |
| 1 | 350 | G.E. | MT18 | 2300 | 400 |
| 1 | 315 | G.E. | Syn. | 2200 | 720 |
| 1 | 200 | West. | Syn. | 2300 | 1200 |
| 1 | 200 | West. | MW | 440 | 600 |
| 1 | 150 | Ideal | Syn. | 220 | 1200 |
| 1 | 125 | West. | Syn. (3 brg.) | 550 | 600 |
| 1 | 125 | Cent. | SC | 440 | 1800 |
| 2 | 100 | G.E. | Syn. | 440 | 300 |
| 1 | 75 | West. | CW | 440 | 1200 |
| 1 | 60 | West. | CW | 440 | 720 |
| 1 | 50 | West. | CS | 440 | 3600 |
| 2 | 50 | Cent. (new) | SC | 220 | 1200 |
| 1 | 40 | G.E. | MT536 | 440 | 900 |
| 1 | 30 | G.E. | MT532 | 440 | 900 |
| 2 | 25 | G.E. | MT332 | 440 | 900 |

## AIR COMPRESSORS

1—12,000 CFM Ingersoll-Rand Turbo Compressor, 3.25# pressure, 250 HP, 3/60/440/3600 RPM.

1—1050 CFM Ingersoll-Rand ES1, 17¾x13, 50 lb. PSI, 275 RPM, V-belt.

1—880 CFM Worthington Syn. motor drive 150 H.P. 3/60/440/277 RPM, size 17x10½x12.

2—528 CFM Chicago NSB, 100 lb., 285 RPM V-belt 14x12.

2—368 CFM Ingersoll ER-1, 285 RPM, 100 psi., 50 HP direct gear, M.D. 3/60/220.

1—360 CFM Schramm Vertical V belted on steel base, 75 HP motor 3/60/220.

1—277 CFM Chicago PB4 Air Cooled 50 HP V-Belt Motor Drive.

1—254 CFM Chicago Pneumatic NSB-125# Belt Drive 40 H.P.

2—245 CFM Ing. Rand 10x10 ER-1, 125#.

1—215 CFM Penna. 3A 10x8, 50 lb.

2—175 CFM Ingersoll ER-1, 9x8, 300 RPM, 100 LB., V-belt.

## CENTRIFUGAL PUMPS

| Q | GPM | TNH | Description | Size | HP | Speed |
|---|---|---|---|---|---|---|
| 2 | 10,000 | 200′ | LeCourtenay | 20″ | 624 | 870 |
| 2 | 10,000 | 100′ | LeCourtenay | 20″ | 350 | 870 |
| 1 | 10,000 | 114′ | De Laval | 18″ | 370 | 988 |
| 1 | 9,000 | 88′ | De Laval | 18″ | 250 | 870 |
| 2 | 8,150 | 132′ | LeCourtenay | 16″ | 350 | 1150 |
| 1 | 8,000 | 110′ | Worthington | 14″ | 500 | 1200 |
| 2 | 7,000 | 200′ | LeCourtenay | 16″ | 423 | 1000 |
| 2 | 6,500 | 100′ | Worthington | 14″ | 200 | 1200 |
| 1 | 6,000 | 110′ | Ingersoll-Rand | 12″ | 500 | 1200 |
| 2 | 5,000 | 125′ | Worthington | 14″ | 200 | 1200 |
| 1 | 4,000 | 110′ | Ingersoll-Rand | 12″ | 500 | 1200 |
| 1 | 3,500 | 47′ | Southwalk | 12″ | 75 | 870 |
| 1 | 3,100 | 42′ | Worthington | 12″ | 50 | 1150 |
| 2 | 2,550 | 200′ | De Laval | 8″ | 200 | 1750 |
| 1 | 2,310 | 24′ | Worthington | 12″ | 20 | 860 |
| 2 | 1,700 | 95′ | De Laval | 10″ | 60 | 1750 |
| 1 | 1,500 | 231′ | Allis-Chalmers | 8″ | 150 | 1750 |
| 3 | 1,200 | 40′ | Worthington | 6″ | 15 | 1750 |

## TURBO GENERATORS

1—625 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Condensing 180 PSI 35 lb. B.P. New 1936.

1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.

1—300 KW West. 3 wire 125/250 Volt D.C., Non-Cond. Turbo Units 125 PSI, 5 lb. B.P. New 1938—(See Actual Photo.)

1—75 KW G.E. Non-Cond. D.C. 125 volt.

1—35 KW G.E. Non-Cond. D.C. 125 volt.

## BOILERS (ASME)

1—106 H.P., Keeler, Self-contained, 125#

2—240 H.P., Keeler, Horizontal, Long-Drum, Water Tube, 200#

1—250 H.P., Bigelow, Self-contained, 125#

2—360 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr., Water wall, 250#

1—390 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr. Water wall, 300#

*3—300 KW D.C. TURBOS—125/250 Volt*

*"Everything from a Pulley to a Powerhouse"*

SINCE 1915

**THE O'BRIEN MACHINERY CO.**

T.M. REGISTERED U.S. PATENT OFFICE

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## . . . YOU CAN FIND EQUIPMENT YOU NEED

*Stocks - on - hand*

Our modern plant houses one of the nation's largest stocks of motors and equipment. Here you will find row upon row of motors, rebuilt and ready for use to meet your requirements. From this complete stock you can be sure that you will find what you need and that it is quality equipment fully guaranteed.

## GUARANTEED REBUILT POWER EQUIPMENT

### HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

#### SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 1000 | *G.E. (New) | K63478 | 1800 |
| 750 | *G.E. | RT | 720 |
| 550 | *G.E. | KP-559 | 2000 |
| 500 | *G.E. | PBG | 1800 |
| 500 | *Pr-Morse | HS | 1200 |
| 450 | *G.E. | KP-5678 | 1200 |
| 400 | *Cont. (New) | NZ | 1800 |
| 400 | *G.E. | IK | 514 |
| 350 | *Cr.-Wh. | 8C | 3600 |
| 300 | *Westgh. | CS | 3600 |
| 300 | G.E. | IE-K | 1200 |
| 300 | A.C. | AR | 900 |
| 300 | Westgh. | CS | 514 |
| 250 | *L.-Allis | OGX-1488 | 720 |
| 250 | Westgh. | CS | 600 |
| 200 | *G.E. | IK-13B | 1800 |
| 200 | *G.E. | IK | 514 |
| 150 | G.E. | KT-548 | 1800 |
| 150 | G.E. | IK | 1800 |
| 150 | G.E. | KTP | 1200 |
| 150 | Westgh. | C8050A | 600 |
| 125 | West. (New | C8504 | 3600 |
| 125 | *A.C. | AR-226 | 1800 |
| 125 | G.E. | K63268 (TEFC) | 1200 |
| 125 | A.C. (New) | AW | 1200 |
| 125 | G.E. (New) | K6333 | 900 |
| 100 | A.C. (New) | ARWWT | 3600 |
| 100 | *G.E. | FT542Z | 1800 |
| 100 | G.E. | FTRP | 1800 |
| 100 | *Westgh. | CS | 1800 |
| 100 | A.C. (New) | AW | 1200 |
| 100 | Ballance (New) | AAC (TEFC) | 1200 |
| 100 | U.S. (Vert.) | *PU | 1200 |
| 100 | G.E. | KT558S | 720 |
| 75 | West. (New) | C85058 | 1800 |
| 75 | G.E. | KT-316 | 1200 |
| 75 | Triumph | TR16 | 514 |
| 75 | G.E. | IK | 600 |
| 75 | G.E. | IK | 514 |
| 60 | *Westgh. | C8504 | 1800 |
| 60 | G.E. | KT533 | 1800 |
| 60 | A.C. (New) | APZ445S (TEFC) | 1800 |
| 60 | A.C. (New) | AR826D | 900 |
| 60 | A.C. | AR826F | 514 |
| 50 | A.C. (New) | APZ444 (TEFC) | 1800 |
| 50 | West. (New) | C8-445 (TEFC) | 1800 |
| 50 | G.E. | KT527 | 1800 |
| 50 | U.S. (Vert.) | SCV827 | 1800 |
| 50 | West. | C8640 | 1800 |
| 50 | Howell (New) | K-504 (TEFC) | 1200 |
| 50 | G.E. | KT-330 | 1200 |
| 50 | Westgh. | C8-504 | 1200 |
| 50 | G.E. | KT343 | 1200 |
| 50 | *G.E. | KTSP | 900 |

Hundreds of Smaller Motors

#### SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 2500 | *G.E. | MT | 257 |
| 1200 | *Cr.-Wh. | | 240 |
| 800 | *A.C. | 3 Brg. | 450 |
| 650 | Westgh. | HE | 350 |
| 600 | *G.E. | MI17B | 900 |
| 500 | Westgh. | CW | 350 |
| 400 | A.C. | 3 Brg. | 450 |
| 400 | *G.E. | MT-412 | 450 |
| 400 | *G.E. | IM-18 | 1800 |
| 300 | *G.E. | MT-410 | 450 |
| 250 | *G.E. | MT-422 | 900 |
| 200 | G.E. | IM | 1800 |
| 200 | *G.E. | IM-16 | 900 |
| 150 | *G.E. | IM-16 | 600 |
| 125 | *G.E. | MT-540 | 1800 |
| 125 | G.E. (New) | M8328 | 900 |
| 125 | G.E. (New) | M8324 | 720 |
| 100 | A.C. | ANY | 900 |
| 100 | Westgh. | CW | 514 |
| 100 | G.E. | IM | 450 |
| 75 | *A.C. | | 900 |
| 75 | Star | OSOO | 900 |
| 75 | G.E. | IM-14 | 1800 |
| 60 | G.E. (New) | M5308 | 1200 |
| 60 | Westgh. | CW | 900 |
| 50 | G.E. | IM11A | 1800 |
| 50 | A.C. | ABT | 1800 |
| 50 | Westgh. | CW | 1200 |
| 50 | G.E. | MT348 | 720 |
| 50 | G.E. | IM | 600 |
| 50 | G.E. | IM14 | 425 |
| 40 | G.E. | MT336 | 1200 |
| 40 | Westgh. | CW414 | 900 |
| 40 | G.E. (New) | M1504U | 900 |
| 35 | Pr-Morse (Vert.) | UAB | 1800 |
| 35 | G.E. | IM | 1200 |
| 30 | G.E. | MT582 | 900 |
| 30 | Westgh. | CW445 | 900 |
| 25 | G.E. | IM-11 | 1200 |
| 25 | A.C. | ART220 | 900 |

#### SLIP RING MOTORS

Crane and Hoist Type 30/60/220 or 440 volts

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 75 | Westgh. | CI756A | 600 |
| 50 | GE | ITC-5013 | 900 |
| 50 | Westgh. | MW-334 | 600 |
| 25 | Westgh. | CI572 | 900 |
| 20 | Westgh. | CI | 900 |
| 15 | G.E. | ITC5010-25 Cy. | 720 |
| 11 | Westgh. | CI464 | 900 |
| 6½ | B & M | 425A (TENV) | 1200 |
| 5 | G.E. | MTC-5730 | 1800 |
| 3 | G.E. | MTC5160 | 1200 |

#### AIR COMPRESSORS

| Size | Make | Type | Displ. | PSI |
|---|---|---|---|---|
| 9x9 | Worth. | HB | 211 | 100 |
| 9x8 | Ing.-R | ER-F | 115 | 100 |
| 8½x9 | Worth. | HB | 170 | 100 |
| (New) | | HB | 122 | 100 |
| 7x7 | Worth. | | | |

#### AC SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

| H.P. | Make | Type | P.F. | Speed |
|---|---|---|---|---|
| 800 | G.E. | TS984 | 1.0 | 1800 |
| 750 | *Westgh. | | .8 | 900 |
| 700 | G.E. | TS | | 514 |
| 350 | *A.C. | Dr Pf | 1.0 | 720 |
| 300 | Cr-Wh. | ENG | 1.0 | 300 |
| 300 | G.E. | ATI-8 | .8 | 900 |
| 250 | *A.C. | Dr Pf | .8 | 720 |
| 220 | G.E. | ATI | 1.0 | 600 |
| 190 | El. Machy. | Ped | 1.0 | 450 |
| 150 | El. Machy. | EM | .8 | 720 |
| 150 | *Westgh. | | 1.0 | 300 |
| 125 | Parkinson | | | 900 |
| 125 | *El. Machy. | SYN | 1.0 | 900 |
| 125 | Cr-Wh. | 103S | 1.0 | 900 |
| 125 | *G.E. | TS | 1.0 | 277 |
| 115 | El. Machy. | EM | 1.0 | 240 |
| 100 | Cr-Wh. | 103S | .8 | 900 |
| 100 | G.E. | ATD | .8 | 900 |
| 100 | Ideal | SM8 | 1.0 | 900 |
| 75 | G.E. | ATI | 1.0 | 900 |
| 60 | G.E. | TS7536 | 1.0 | 1200 |
| 40 | G.E. | KTB | .8 | 1200 |
| 20 | Fynn-W. | 15VRN | | 1200 |
| 15 | Century | ARC365 | 1.0 | 1200 |
| 4 | G.E. | AK 25 Cy. | | 1500 |

#### DIRECT CURRENT MOTORS

230 Volts

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 1000 | Westgh. | (600V) | 400/800 |
| 400 | Westgh. | | 800/1200 |
| 375 | Westgh. | Ped | 650 |
| 200 | Westgh. | SK210 | 800 |
| 175 | Ballance | 1400T | 875 |
| 175 | G.E. | KLC11 | 750 |
| 125 | G.E. | Marine | 1200 |
| 100 | G.E. | RC34 | 2500 |
| 100 | Westgh. | SK175 | 850 |
| 100 | A.C. | R153 | 575 |
| 40 | Cr-Wh. | CMC | 1750 |
| 40 | G.E. | CO2004 | 600 |
| 35 | Cr-Wh. | CMC301 | 700 |
| 35 | G.E. | C | 800 |
| 30 | Westgh. | SK120 | 975 |
| 30 | Cr-Wh. | CCM | 650 |
| 30 | Westgh. | SK933 | 1750 |
| 30 | G.E. | BC 31B | 1150 |
| 25 | Westgh. | SK115 | 850 |
| 25 | Westgh. | SK126L | 1150 |

MANY OTHERS—1 HP and UP! ALSO 115 VOLT

#### D. C. MOTORS— ADJUSTABLE SPEED

230 Volts (*115 Volt)

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 30 | G.E. | C | 300/900 |
| 30 | Westgh. | SA-8 | 800/1800 |

#### DIESEL-GENERATORS (2)

NEW—81.25 KVA Nagara AC Generators, 3/60/120/208, D/C Exciter driven by direct-connected Cummins Diesel Engine, Model H-1. Complete Control Panel.

#### HI-PRESSURE PUMPS

| GPM | Make | Type | Head |
|---|---|---|---|
| 800 | Worth. | 6DS | 925 Ft. |
| 500 | Manistee | H | 250 Ft. |
| 300 | Al.Ch. | NMZ | 800 Ft. |

#### ROTARY CONVERTER

1000 KW Westinghouse, 900 RPM, 600 Volt DC; 6 phase, 60 cycle AC, with complete automatic control.

#### AC SYNCHRONOUS GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

| KVA | Make | Type | P.F. | Speed |
|---|---|---|---|---|
| 1500 | G.E. | ATI | .8 | 900 |
| 1000 | *Westgh. | 303D | .8 | 900 |
| 250 | *Al-Ch (New) | | .8 | 720 |
| 150 | El. Machy. | EM | .8 | 720 |
| 110 | Cr-Wh. | 103 | .8 | 900 |
| 100 | *G.E. | ATB | .8 | 900 |
| 60 | Pr-Morse | B | .8 | 900 |
| 55 | G.E. | ATB | .8 | 1200 |
| 50 | G.E. | ATB | .8 | 1200 |
| 50 | Westgh. | | .8 | 1200 |
| 50 | Cr-Wh. | 508S | .8 | 1200 |
| 37.5 | Al-Ch. | EA121 | .8 | 1800 |

#### TRANSFORMERS

3—2000 KVA Pittsburgh, 1 Phase 12,000 V to 2300 V

1—750 KVA Westinghouse, AIR—3 Phase 13,800 V to 480 V

1—750 KVA Westinghouse—AIR—3 Phase 13,800 V. to 2300/4160 V.

3—667 KVA Niagara, 1 Phase 13,000 V. to 480 V.

3—300 KVA General Electric, 3 Phase 13,800 V. to 240/480 V.

3—300 KVA General Electric, 3 Phase, 2400 V to 240/480 V.

#### 1000 KW MOTOR-GENERATOR SET—3-UNIT

2—500 KW Westgh. DC Gens., 275/137.5 V, 3 wire, 1820 Amps. D/C TO 1420 HP Westgh. Syn. Motor, 900 RPM 11,000 V. 60 Cy., 3 Ph. 3 Brg. on Castiron Factory Base.

#### MOTOR-GENERATOR SETS

| K.W. | Make | A.C. | D.C. |
|---|---|---|---|
| 500 | Westgh. | 2300 | 250 |
| 500 | Westgh. | 550 | 250 |
| 500 | Cr-Wh. | 220/440 | 250 |
| 450 | G.E. | 2200 | 125/250 |
| 400 | Westgh. | 2300 | 600 |
| 250 | West-GE | 440 | 250 |
| 200 | CrWg | 440 | 250 |
| 200 | Ridgeway | 2200 | 250 |
| 150 | G.E. | 2300/400 | 250 |
| 150 | G.E. | 440 | 250/275 |
| 150 | Cr-Wh | 440 | 250 |
| 150 | Al-Ch. | 220 | 125 |
| 100 | G.E. | 440 | 250 |
| 100 | G.E. | 220 | 250 |
| 100 | G.E.-Delco | 440 | 120/240 |
| 75 | Al-Ch | 440 | 250 |
| 75 | Westgh. | 2300 | 110 |
| 60 | Al-Ch. | 2300 | 110 |
| 40 | Cr-Wh | 220 | 125 |

*First Source for 41 Years for Quality Electrical Equipment*

**CHICAGO** *Electric Co.*

1320 W. CERMAK ROAD — CHICAGO 8, ILL.



## TRANSFORMERS
### FOR SALE

1 Phase, 60 Cycle

3—500 KVA G-E 66000—2300
2—500 KVA W-H 13200—240/480
3—400 KVA W-H 13200—600/575/550
3—333 KVA G-E 44000/33000—2400/500
3—250 KVA W-H 13800—2300
3—200 KVA G-E 13200—120/240
3—150 KVA G-E 44000—6600
3—100 KVA G-E 33000—6900/11950Y
3— 50 KVA A-Ch 33000—2400/4160Y

3-Phase, 60 Cycle

2— 750 KVA W-H 13800—460 DRY
1—4000 KVA W-H 1500/12750 Auto

*Many other items in stock*

**TRANSFORMERS WANTED**

Reliable rewind and repair service on all makes of transformers

**THE ELECTRIC SERVICE CO.**
CINCINNATI 27, OHIO



## STEAM GENERATOR
### (A-1 condition)

87,000 lbs. steam per hr. — 350 psi.

87% EFFICIENCY

Design includes Water Walls, Economizer, Air Pre-Heater. Also forced draft and induced draft fan. Complete steel casing.

**STEPHEN A. DOUGLASS CO.**
620 Fort Washington Ave., New York 33, N. Y.



Nordberg-G.E. Diesel-Elec. Generator Set 875 KW.
A-C 625 KW turbo-generator, 440 v., non-cond., 1402.
F-Morse 32-D 282 KW diesel-elec. gen. sets (2).
Cooper Bessemer 1000 HP diesels, rev., new (2).
Locomotives, 7 to 65 ton, diesel, gas, steam.
Ind. Brownhoist 30-ton diesel locomotive crane.
Gantry-bridge coal crane 1-yd., electric.
American, Clyde, Colby Whitley gantry cranes (5).

**H. Y. SMITH COMPANY**
828 N. Broadway — Milwaukee 2, Wis.



## FOR SALE
### *AVAILABLE AT ONCE*

**COMPLETE DIRECT DRIVE DIESEL POWER PLANT, with 50 KVA electric generator belted to drive shaft.**

**DIESEL EQUIPMENT: one 112½ HP engine and one 75 HP engine and complete supplementary equipment, including a 12,000 gal. fuel oil storage tank, to make a complete operating installation.**

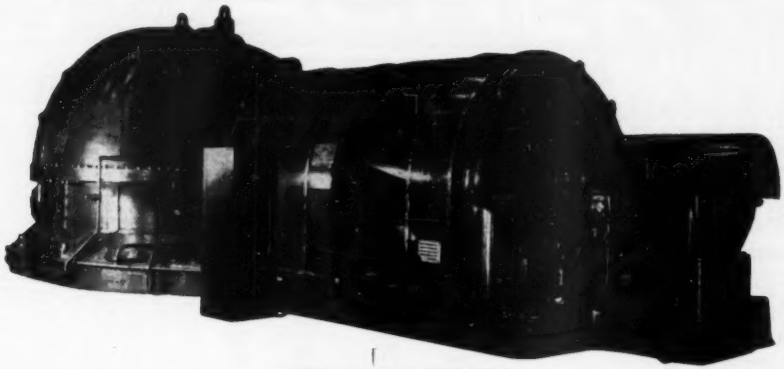
**GENERATING EQUIPMENT: one 50 KVA generator, one dc generator, switchboard panel and instruments and voltage regulator.**

**PRICE: All, loaded on cars, fob Greensburg, $7,820.00.**

**CONTACT: for details**

**GREENSBURG ICE CO.**
**GREENSBURG — INDIANA**
*Attention CHAS. F. SCHEIDLER*

**25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° total temperature complete with direct connected shaft exciter, switchboard and instruments, a 30,000 square foot 2-pass Westinghouse surface condenser, motor driven and turbine driven pumps and condensing accessories.**



ACTUAL PHOTOGRAPHIC VIEW

## *EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY*

### TURBINE-GENERATOR UNITS

*Condensing—3 phase, 60 cycle*

6250 KVA G.E., 5-stage, 2300/4000 volts, 200# P.S.I., 600° TT.

4000 KVA Allis, 2300 volts, 150-200 PSI.

3750 KVA Allis, 2300 volts, 125-175 PSI.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator LESS TURBINE.

2500 KVA G.E. 600 volts, 200 PSI.

1875 KVA Westghse. 2300 volts, 250 PSI.

1563 KVA Allis, 600 volts, 200 PSI.

1250 KVA G.E. AUTOMATIC EXTRACTION BLEEDER 2300 volts, 250 PSI.

937 KVA Allis, 480 volts, 250 PSI.

780 KVA Allis, 480 volts, 150 PSI.

625 KVA G.E. 480 volts, 150 PSI.

*Non-condensing—3 phase, 60 cycle*

940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.

625 KVA G.E. 480 volts, 125-150 PSI, 20# back.

375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.

300 KVA Allis 480 volts, 125 PSI, 10# back.

125 KVA G.E., 2300 volts, 150-200 PSI, 10# back.

125 KVA Westghse. 2400 volts, 150-250 PSI 10# back.

*Direct Current*

500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.

100 KW (2) G.E., 125 volts, 200-275 PSI.

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing.

### MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, 900 RPM alternator direct connected 135 HP, 250 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

50 KW G.E. 125 volt direct current 1200 RPM to a 3 phase, 60 cycle, 220 volt syn. motor.

10 KW G.E. 125 volts direct current to 12 HP 60 cycle, 220 volt motor.

*NOVEMBER BARGAINS*
*SPECIALLY PRICED*

1250 KVA E.M. 3 phase, 60 cycle, 4000/2300 volts synchronous generator direct connected to a 38D8-1/8 O.P. Fairbanks-Morse Diesel Engine.

2—Elliott twin oil strainers connected to a 25 HP, 3 phase, 60 cycle, 220 volt G.E. totally enclosed motor, practically new.

1—4400 sq. ft. Worthington surface condenser.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I. non-cond. G.E. turbine.

### SYNCHRONOUS MOTORS

*3 phase, 60 cycle*

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Syn. (condenser).

900 HP Allis, 2200 volts, 150 RPM.

### UNAFLOW GENERATOR UNITS

*Alternating Current—3 phase, 60 cycle*

500 KVA G.E., 2400/480/240 volts generator connected Ames Vertical Engine, 150 PSI—5# back.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal engine, 125-150 PSI.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

*Direct Current*

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.

250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.

25 KW (2) Allis 250 volt, 500 RPM generators each direct connected American Blower vertical engine.

20 KW Louis Allis 125 volt generator connected Hill vertical Diesel engine MODERN.

**UMC UTILITIES MACHINERY CORP.**
**1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422**

# BREW-WOLTMAN OFFERS

### TURBINE UNITS

1—15000 KVA G.E. Cond. 60 cy. 13200 V. 275-lb.
1—12500 KVA Allis Cond. 60 cy. 13800 V. 300-lb.
1—10000 KVA G.E. Cond. 25 cy. 6000 V. 200-lb.
1— 6250 KVA Allis Cond. 60 cy. 4000 V. 175-200-lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 385-lb.
1— 3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200-lb. 40-lb. BP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200-lb. Steel Valve Chest.
2— 2250 KVA G.E. Cond. 60 cy. 240-460-lb.
1— 1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1— 1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1— 1563 KVA G.E. Extr. Cond. 60 cy. 2300 V. 200-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200-lb.
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA G.E. Non-C. 60 cy. 2300 V. 180-lb. 35-lb. BP
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP

### DIESEL ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1—1800 HP Superior 2300 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
2— 550 HP Amer. Loco. 440 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

### STEAM ENGINE UNITS

1—875 KVA Chase Corliss 2300 V.
1—375 KVA Skinner Uniflow 480 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

### ROTARIES — 60 CY.

| QU. | KW | MFR. | VOLTS-DC | TRANS. | RPM |
|---|---|---|---|---|---|
| 1 | 3250 | G.E. | 225/275 | 13800 | 360 |
| 3 | 1000 | G.E. | 600 | 13200 | 900 Auto. |

### SYNCHRONOUS CONDENSERS

| QU. | KVA | MFR. | VOLTAGE | RPM |
|---|---|---|---|---|
| 1 | 2500 | G.E. | 2400/4160 | 720 |
| 1 | 2000 | West. | 2300 | 720 |
| 1 | 1500 | G.E. | 4000 | 900 |
| 1 | 1500 | West. | 2300 | 900 |

### SPECIAL

1—150 HP General Electric synchronous motor starter, cubicle type, type CR-7811, across-the-line, reversing, dynamic breaking.

### MERCURY ARC RECTIFIERS

| QU. | KW | KIND | DC VOLTS | TRANS. |
|---|---|---|---|---|
| 2 | 4500 | Multi Anode | 600 | 13800 |
| 4 | 3250 | Ignitron | 650 | 33000 |
| 2 | 1850 | Ignitron | 350 | 33000 |

### MOTOR GENERATOR SETS—60 CY.

| QU. | KW | MFR. | VOLTS-DC | A.C. | RPM |
|---|---|---|---|---|---|
| 2 | 1500 | G.E. | 600 | 13200 | 720 |
| 1 | 1000 | G.E. | 600 | 13200 | 514 |
| 1 | 500 | West. | 125 | 2300 | 720 |
| 1 | 400 | G.E. | 250 | 6600 | 720 |
| 1 | 75 | West. | 125 | 440 | 1200 |

### SYNCHRONOUS MOTORS—60 CY.

| QU. | HP | MFR. | VOLTAGE | RPM |
|---|---|---|---|---|
| 1 | 4350 | Cr. Wh. | 13800 | 514 |
| 2 | 1750 | G.E. | 2200 | 3600 |
| 2 | 700 | West. | 2300 | 300 |
| 1 | 600 | G.E. | 440 | 360 |
| 2 | 350 | G.E. | 2300 | 257 |
| 1 | 300 | G.E. | 2300 | 600 |
| 1 | 300 | West. | 2300 | 900 |
| 1 | 115 | West. | 440 | 1200 |
| 1 | 110 | Ridgway | 220 | 1200 |

### FREQUENCY CHANGERS

| QU. | KVA | MFR. | CYCLES | RPM |
|---|---|---|---|---|
| 1 | 3125 | G.E. | 25/60 | 300 |
| 1 | 3000 | G.E. | 60/25 | 300 |
| 1 | 2500 | G.E. | 25/62½ | 750 |
| 1 | 2450 | G.E. | 62½/25 | 750 |
| 1 | 1700 | West. | 60/24 | 720 |
| 1 | 1500 | G.E. | 25/62½ | 750 |
| 1 | 1250 | G.E. | 25/60 | 300 |

### TRANSFORMERS — 60 CY.

1— 7500 KVA G.E. 138000—41000, 3 ph.
3— 3333 KVA West. 132000—7620/13200 Y
3— 1000 KVA West. 66000—7200
3— 500 KVA G.E. 66000—2400
1— 2500 KVA G.E. 59/73 KV—5 taps, 3 ph.
4— 2300 KVA West. 44000—11000
3— 1500 KVA Wag. 44000—6900 NEW
1— 200 KVA Mal. 44000/22000—440/220
3— 75 KVA West. 44000—7200/12470
3— 8333 KVA West. 43800—13800
3— 100 KVA Wag. 36000—7200/12470 Y
1—18750 KVA A.B.B. 34840—11000, 3 ph.
6— 1500 KVA Pitts. 33000—2400
3— 200 KVA West. 33000—7200/12470 Y
3— 200 KVA West. 33000—2400
3— 167 KVA G.E. 33000—2300/4000 Y
6— 150 KVA G.E. 34500—2300/4600
4— 150 KVA G.E. 33000—7200/12470 Y
3— 100 KVA A.C. 33000—7200/12470 Y
3— 75 KVA Mal. 33000—2300/6900
3— 75 KVA Wag. 33000—7200/12470 Y
6— 50 KVA G.E. 33000—2300
4— 450 KVA A.C. 23410/44000—13280/23000
4— 750 KVA Wag. 19050/33000 Y—6900/11950
3— 333 KVA G.E. 13800/6900—2300
2— 200 KVA G.E. 11500—220/110
3— 200 KVA Mal. 11000—2300
3— 150 KVA Mal. 7620/13200 Y—120/240
3— 667 KVA Kuhl. 7200/12470 Y—2400
3— 37½ KVA Pitts. 6900—230/460
3— 75 KVA West. 6600—460/230
1— 100 KVA G.E. 2300—575, 3 ph.
3— 100 KVA Kuhl. 550—220/110
3— 15 KVA Stand. 450/225—117

### OIL CIRCUIT BREAKERS

| | |
|---|---|
| 4—600 A. 154 KV G.E. FHKO-39-2500 | Outdoor |
| 1—600 A. 73 KV G.E. FHKO-236-500 | Outdoor |
| 1—400 A. 37 KV G.E. FHKO-136-350 | Outdoor |
| 1—400 A. 37 KV West. O-221-500 | Outdoor |
| 1—400 A. 15 KV G.E. FKO-37-40 | Outdoor |
| 4—600 A. 15 KV G.E. FHKO-139 750 | Outdoor |

*PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT*

## BREW. WOLTMAN & CO., INC.

50 Church Street — New York City 7, — WOrth 4-1470

# POWER PLANT EQUIPMENT

## SPECIAL OFFERINGS

### TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# N.C.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 260# N.C.
2—1000 KW, 480 V., 180# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 500 KW, 2300 V., 165# Cond.
1— 300 KW, 2300 V., 150# Cond.
1— 150 KW, 2400 V., 150# N.C.

### ENGINE GENERATORS

1—600 KW, 2300 V., Unif.
1—500 KW, 238 V., D.C., Unif.
3—375 KVA, 550 V., Unif.
1—312 KVA, 440 V., Unif.

### DIESEL GENERATORS

1—1000 KVA, 2400 V.
3— 540 KW, 480 V.

### BOILERS

1—30,000#, 425#
1— 1,000 HP, 250#
2— 500 HP, 200#
1— 438 HP, 200#
2— 300 HP, 250#
2— 250 HP, 200#
6— 150 Hp, 150# Sc. Mr.
1— 78" H.R.T., 200#

*Write or wire for additional data and prints.*

**A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.**

*THE BUYERS MUST BE SATISFIED—ALWAYS*

# COMPLETE POWER PLANTS

**STEAM — ELECTRIC — HYDRO — DIESEL**

*"Export Orders Carefully Executed"*

**IMMEDIATE DELIVERY** —2-ea. 60,000# hr. capacity 4-Drum Stirling type, 250# psi. (10,000 sq. ft. H.S.) 525° F.TT Boilers. Condition excellent, suitable any fuel, now oil fired.

1—48,000# hr. capacity Boiler, otherwise same as 60,000# (8,500 sq. ft. H.S.) above boilers.

● We have many other boilers in sizes of 250 to 600 HP, 200 to 450# pressure. See our September Power ad.

Turbo-Generators, Condensing, 300 to 10,000 KW.
Turbo-Generators, Non-Condensing, 200 to 2500 KW.

Frequency Changers—Motor-Generators & Diesel-Generators

**TRANSFORMERS!** Quick Delivery. Various Sizes Rebuilt like NEW—Guaranteed.

*Send us your* INQUIRIES *for* ALL POWER MACHINERY

**CHARLES B. REARICK** — **30 CHURCH ST.** — **NEW YORK 7, N. Y.**

### ELECTRIC AIR COMPRESSORS

676 FT. WORTHINGTON, 2 STAGE
1302 FT. INGERSOLL RAND PRE-2
1578 FT. SULLIVAN WN-31
2415 FT. INGERSOLL RAND PRE-2
2600 FT. SULLIVAN WN-4
2873 FT. WORTHINGTON, 2 STAGE
3100 FT. SULLIVAN WN-4
3460 FT. CHGO. PNEU. OCTDE

### DIESEL GENERATORS

2—600 KW INGERSOLL RAND 2400 V.
1—600 KW GEN. MOTORS 2400 V.
1—190 KVA BALDWIN DELAVERGNE 440 V.
1—185 KVA FAIRBANKS MORSE 220 V.
1—1600 KW 480 V. INGERSOLL RAND

**DARIEN CORP.**

60 E. 42nd St., N. Y. 17, N. Y.

### SELLING FOR CUSTOMERS

1—375 KVA—240/3/60 Westinghouse geared non condensing turbine.
2—37½ KVA—240 & 480/3/60 Cat. diesel sets.
1—50 KW—220 AC & 250 DC West. M.G. Set.
1—1000 HP—270 lb. Springfield boiler.

What do you need—what have you to sell—We have nationwide outlets to help you when buying or selling equipment.

H. BLANE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

### FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

**PENN MACHINERY COMPANY**
Jackson, Miss.

ELECTRIC MOTORS AND GENERATORS

# WAGNER CERTIFIED REBUILT

BACKED BY 45 YEARS OF QUALITY AND SERVICE

## For QUALITY • SERVICE • PRICE - "Check with WAGNER First!"

**OVER 45 YEARS OF EXPERIENCE is back of every machine sold by Arthur Wagner Company. Large stocks and modern facilities insure ample choice and prompt service at reasonable cost. All Wagner "Certified Rebuilt" equipment conforms to standards approved by National Industrial Service Association. Inspect our shop and stock—see why it pays to . . . "Check with Wagner First!"**

### M-G SETS

| KW | Mfr | Input V | Output V |
|---|---|---|---|
| 500 | G.E. HCC conv. | 2300 AC | 275 DC |
| 300 | Allis Ch. | 2200/440 AC | 125/250 DC |
| 200 | G.E.* | 440 AC | 275 DC |
| 200 | Whse.* | 2300 AC | 275 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 150 | Gen. Elec.* | 2300/440 AC | 600 DC |
| 150 | Whse.* | 220/440 AC | 125/250 DC |
| 105 | Century b.b. | 220/440 AC | 70 DC |
| 100 | Allis Ch.* (2) | 2200/440 AC | 60 DC |
| 100 | Whse. | 230 DC | 220 AC |
| 100 | Whse.* | 220/440 AC | 230 DC |
| 100 | Gen. Elec. | 220/440 AC | 125 DC |
| 100 | Gen. Elec. | 220/440 AC | 250 DC |
| 75 | Whse. (3) | 220/440 AC | 250 DC |
| 75 | Gen. Elec. (3) | 220/440 AC | 125 DC |
| 65 | Whse. | 220/440 AC | 250 DC |
| 60 | Gen. Elec.* | 220/440 AC | 60 DC |
| 50 | Allis Ch. (2) | 220/440 AC | 125/250 DC |
| 45 | Cr. Wh. b.b. | 20/440 AC | 125 DC |
| 40 | Gen. Elec. | 220/440 AC | 550 DC |
| 40 | Whse. (2) | 220/440 AC | 125 DC |
| 40 | G.E. | 220/440 AC | 250 DC |
| 35 | Cr. Wh. b.b. | 220/440 AC | 125 DC |
| 35 | G.E. | 220/440 AC | 48 DC |
| 25 | Gen. Elec. | 220/440 AC | 250 DC |
| 25 | G.E. b.b. New | 220/440 AC | 125 DC |
| 20 | Northw'n. | 220/440 AC | 250 DC |

*Syn. motor drive.

### D.C. MOTORS

| HP | Mfr | Type | Volts | Speed |
|---|---|---|---|---|
| 200 | Gen. Elec. | CD118BA | 230 | 400/1200 |
| 150 | Whse. dynamometer | | 230 | 1000/3000 |
| 150 | Cr. Wh. TEFC | 83H | 230 | 890 |
| 100 | Whse. | SK181 | 230 | 450/900 |
| 100 | Gen. Elec. | C | 230 | 575/1000 |
| 100 | Gen. Elec. | CD125 | 230 | 850 |
| 75 | Whse (2) | SK163 | 230 | 850 |
| 75 | Northw'n | K20 | 230 | 1750 |
| 60 | Cr. Wh. | 50H | 230 | 700 |
| 60 | Reliance b.b. | 851T | 230 | 750 |
| 50 | Gen. Elec. | LC | 115 | 400/800 |
| 50 | Cr. Wheeler | CMC | 230 | 1750 |
| 50 | Century New | R91 | 230 | 690/1150 |
| 40 | Gen. Elec. | RC32 | 550 | 1200 |
| 40 | Gen. Elec. | RC-32 | 230 | 1150 |
| 40 | Cr. Wheeler | 5H | 230 | 1750 |
| 40 | Whse. | SK140 | 230 | 775 |
| 40 | Gen. Elec. (2) | CD115 | 230 | 575/1150 |
| 35/50 | Gen. Elec. | CD122 | 230 | 575/1150 |
| 30 | Whse.. | SK110L | 230 | 1150 |
| 30 | Whse. (2) | SK90 | 230 | 1700 |
| 30 | Star b.b. | 8B | 230 | 1750 |
| 25 | Gen. Elec. | CD85 | 230 | 1750 |
| 25 | Whse. | SK150 | 230 | 300/1200 |
| 25 | G.E. (2) | CD93 | 230 | 1150 |
| 25 | G.E. b.b. New | CDM93 | 115 | 1150 |
| 25 | Gen. Elec. | RP13 | 230 | 250/1000 |
| 25 | Gen. Elec. | CD105 | 230 | 500/1550 |
| 20 | Gen. Elec. (2) | CD83 | 230 | 1750 |
| 20 | Gen. Elec. | RP13 | 230 | 400/1600 |

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS.

### D. C. GENERATORS

| KW | Mfr | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Allis Ch. New | MECW | 125/250 | 1200 |
| 300 | Gen. Elec. 1 brg. | DMC | 375 | 720 |
| 150 | Whse. | SK181 | 125/250 | 900 |
| 105 | Century b.b. | 1500 amp | 70 | 1200 |
| 100 | Gen. Elec. | CD | 250 | 1200 |
| 100 | Gen. Elec. | C | 250 | 750 |
| 75 | Reliance b.b. New | 310T | 250 | 1200 |
| 75 | Whse. | SK | 250 | 1200 |
| 75 | Gen. Elec. | RC36 | 125 | 1200 |
| 65 | Whse. | SK160 | 250 | 1100 |
| 60 | Gen. Elec. | LC | 250 | 700 |
| 50 | Allis Ch. (2) | EW | 125/250 | 1200 |
| 50 | Cr. Wheeler | 50H | 250 | 900 |
| 45 | Cr. Wh. b.b. | PH | 125 | 1750 |
| 40 | Whse. | SK | 250 | 1200 |
| 40 | Gen. Elec. (2) | RC32 | 250 | 1500 |
| 40 | Gen. Elec. | RC32 | 550 | 1500 |
| 25 | Gen. Elec. | CD | 250 | 1500 |
| 25 | G.E. b.b. New | CDM93 | 125 | 1450 |
| 15 | Star b.b. (5) | 8Q | 250 | 1750 |

### A. C. GENERATORS — 60 CYCLE

| KVA | Mfr | Type | Volts | Speed |
|---|---|---|---|---|
| 625 | Gen. Elec. | ATB | 2300 | 450 |
| 625 | G.E. 25 cycle | ATB | 2300 | 750 |
| 500 | Allis Ch. | 3 brg. | 240/480 | 360 |
| 500 | Gen. Elec. | ATB | 240/480 | 900 |
| 300 | Gen. Elec. | ATB | 600 | 720 |
| 275 | G.E. 25 cycle | ATI | 480 | 750 |
| 250 | Whse. | G | 2400/480 | 600 |
| 225 | Gen. Elec. | ATB | 240/480 | 600 |
| 200 | El. Machy. | | 2300 | 900 |
| 125 | Gen. Elec. | ATB | 240/480 | 720 |
| 125 | Gen. Elec. | ATB | 240/480 | 300 |
| 90 | Gen. Elec. | ATI | 240/480 | 1200 |
| 75 | El. Machy. | | 2300 | 900 |
| 75 | Gen. Elec. | ATI | 240/480 | 1200 |
| 56 | Gen. Elec. | ATB | 240/480 | 1200 |
| 56 | Gen. Elec. | ATB | 240/480 | 900 |
| 31 | Whse. b.b. | late | 120/208 | 1200 |
| 10 | Kato New (30) | b.b. | 127/220 | 1800 |

### A. C. MOTORS — SLIP RING
### 3 Phase 60 Cycle 220 or 440 Volts

| QU | HP | Mfr | Type | Speed |
|---|---|---|---|---|
| 1— | 600 | Gen. Elec. | IM | 360 |
| 1— | 500 | G.E. 3 brg. | I-M | 450 |
| 1— | 400 | Gen. Elec. | I-M | 514 |
| 1— | 350 | Whse. 2300V. | CW | 450 |
| 1— | 300 | G.E. 2300V. | I-M | 1800 |
| 1— | 300 | Gen. Elec. | I-M | 720 |

| | | | | |
|---|---|---|---|---|
| 1— | 250 | G.E. 2200V. | IM-17A | 600 |
| 1— | 250 | Allis Ch. 2200V. | ANY | 514 |
| 1— | 250 | Cr. Wheeler | 8R | 600 |
| 1— | 200 | Whse | CW874C | 900 |
| 1— | 200 | Cr. Wheeler | 8R | 600 |
| 1— | 200 | Gen. Elec. | I-M | 360 |
| 2— | 200 | Gen. Elec. | I-M | 600 |
| 1— | 150 | G.E. 2200/4400V. Vert. | I-M | 1200 |
| 1— | 150 | Gen. Elec. | I-M-17 | 450 |
| 1— | 150 | G.E. | IM-16 | 600 |
| 1— | 125 | Allis. Ch. | ANY | 900 |
| 1— | 100 | Gen. Elec. | I-M | 720 |
| 2— | 100 | G.E. New | M-8324 | 1200 |
| 1— | 100 | Gen. Elec. | I-M | 1800 |
| 1— | 100 | G.E. Vertical | MT553 | 1200 |
| 1— | 100 | Cr. Wheeler | 8R | 600 |
| 1— | 100 | Northwestern | HW | 1800 |
| 3— | 75 | Gen. Elec. | MT553 | 900 |
| 1— | 75 | Whse. 2200V. | CW | 600 |
| 2— | 75 | Gen. Elec. | MT343 | 1800 |
| 1— | 60 | G.E. TEFC b.b. | M-6326 | 720 |
| 1— | 60 | Fair. Morse | BV | 720 |
| 1— | 60 | Whse. 2200V. | CW716C | 900 |
| 1— | 60 | Gen. Elec. | MT343 | 1200 |
| 1— | 50 | Allis Ch. | ANY | 900 |
| 1— | 50 | Howell | SR437 | 1200 |
| 1— | 50 | Gen. Elec. Int. | ITC3013 | 600 |
| 2— | 40 | Whse. | CW636A | 1200 |
| 1— | 40 | Gen. Elec. | MT552 | 600 |
| 2— | 30 | G.E. 2200V. | MT332 | 900 |
| 2— | 30 | Gen. Elec. | MT332 | 900 |
| 2— | 25 | Gen. Elec. | MT | 900 |
| 2— | 25 | Gen. Elec. Int. | MTC5526 | 720 |
| 3— | 20 | Whse. b.b. New | CW364 | 1800 |

### A. C. MOTORS — SYNCHRONOUS

| HP | Mfr | Type | Volts | Speed |
|---|---|---|---|---|
| 750 | Gen. Elec. | TS | 2300 | 450 |
| 500 | Gen. Elec. | ATI | 220/440 | 900 |
| 300 | Gen. Elec. | ATI | 2300/550 | 450 |
| 300 | Whse. | G | 2200/440 | 600 |
| 300 | Gen. Elec. | ATI | 440 | 720 |
| 275 | G.E. 25 cycle | | 2300/440 | 750 |
| 250 | Gen. Elec. | TS | 220/440 | 360 |
| 225 | El. Machy. | BRKT | 220/440 | 1800 |
| 200 | Allis Ch. (2) | .8PF | 2200/440 | 720 |
| 220 | G.E. 3 brg. .8 PF | ATI | 220/440 | 600 |
| 200 | El. Machy. (2) | .8PF | 2300 | 900 |
| 200 | G.E. | TS | 220/440 | 150 |
| 190 | El. Machy. | 3 brg. | 220/440 | 514 |
| 175 | Whse. | 2 brg. | 220/440 | 300 |
| 150 | Gen. Elec. | ATI | 220/440 | 720 |
| 150 | Gen. Elec. | ATI | 220/440 | 300 |
| 125 | El. Machy. (2) | | 220/440 | 1800 |
| 120 | Burke b.b. .8PF | AC19 | 2200/440 | 1200 |
| 125 | El. Machy. | B.B. | 2400/4800 | 900 |
| 100 | American b.b. | TGH | 220/440 | 900 |

### A. C. MOTORS — SQUIRREL CAGE
### 3 Phase 60 Cycle 220 or 440 Volts

| QU | HP | Mfr | Type | Speed |
|---|---|---|---|---|
| 1— | 500 | Fair. Morse 2200V. | HS | 1200 |
| 1— | 300 | G.E. 2200V. | KTP561 | 1800 |
| 1— | 300 | Gen. Elec. | I-K | 600 |
| 2— | 250 | Whse. 2200V. | CS | 1200 |
| 1— | 250 | Gen. Elec. | FT549AZ | 3600 |
| 1— | 250 | Gen. Elec. | IK-17A | 450 |
| 1— | 250 | Gen. Elec. | IK-17 | 600 |
| 1— | 250 | Gen. Elec. | I-K | 720 |
| 1— | 200 | Gen. Elec. | IK-17 | 514 |
| 2— | 200 | Reliance b.b. New | B60858 | 1800 |
| 2— | 200 | Gen. Elec. | I-K | 600 |
| 1— | 200 | G.E. 3 brg. | I-K | 400 |
| 1— | 200 | Gen. Elec. | KT566 | 600 |
| 1— | 200 | U.S. b.b. New | 6C587 | 1200 |
| 2— | 200 | Gen. Elec. | I-K-E13B | 1800 |
| 1— | 150 | Reliance b.b. New | C6085 | 900 |
| 1— | 150 | Gen. Elec. | KT549 | 1800 |
| 2— | 150 | Gen. Elec. 2200V. | IK-15A | 720 |
| 1— | 150 | Gen. Elec. | IK-16 | 600 |
| 1— | 150 | U.S. b.b. | 8A | 900 |
| 1— | 150 | Gen. Elec. TEFC b.b. | K6333S | 1200 |
| 1— | 150 | Gen. Elec. | IK-17 | 450 |
| 1— | 150 | Whse | CS | 720 |
| 8— | 125 | AL. Ch. 2200V. b.b. | ARX-826 | 900 |
| 2— | 125 | Rel. TEFC New | B6085S | 1800 |
| 2— | 125 | Gen. Elec. | K-558 | 900 |
| 1— | 125 | G.E. b.b. New | K6324S | 1200 |
| 2— | 125 | G.E. New b.b. HT | KG6324 | 1200 |
| 1— | 125 | Cen. 2200V. b.b. | 8C | 1800 |
| 2— | 125 | G.E. 2200V. TEFC | K6326 | 3600 |
| 2— | 125 | Reliance b.b. New | 5058 | 1800 |
| 1— | 125 | Reliance b.b. New | B6085 | 900 |
| 2— | 100 | Reliance b.b. New | B5048 | 1800 |
| 1— | 100 | Reliance TEFC New | B5085 | 1200 |
| 1— | 100 | Whse. | CS | 720 |
| 1— | 100 | Gen. Elec. | I-K | 1200 |
| 1— | 100 | Rel. TEFC New | 5058 | 3600 |
| 1— | 75 | Rel. TEFC New | 5048 | 3600 |
| 1— | 75/90 | Gen. Elec. | IK | 3600 |
| 2— | 75 | Whse. | CS | 720 |
| 1— | 75 | Fair. Morse b.b. | HJQ | 600 |
| 1— | 75 | Reliance b.b. NEW | C8084 | 900 |
| 1— | 75 | Reliance b.b. NEW | C5085 | 1800 |
| 1— | 75 | G.E. TEFC 2200V. | K-6325 | 900 |
| 2— | 75 | Gen. Elec. | KT543 | 1200 |
| 2— | 75 | Gen. Elec. | I-K-14 | 600 |
| 1— | 75 | G.E. Expl. Pf. 2200V. | K6325 | 1206 |
| 2— | 60 | Gen. Elec. | KT546 | 900 |
| 2— | 60 | Howell b.b. | K504 | 1200 |
| 1— | 60 | Gen. Elec. | KT556 | 450 |
| 1— | 60 | Reliance b.b. New | CC505 | 900 |
| 2— | 60 | G.E. Vertical | KT536 | 1200 |
| 1— | 60 | Gen. Elec. | I-K | 600 |
| 3— | 60 | G.E. 2200V. | KT533 | 1800 |
| 2— | 60 | Reliance b.b. NEW | B504 | 1800 |
| 1— | 60 | Reliance TEFC NEW | C505 | 1200 |
| 2— | 50 | Gen. Elec. | KT546 | 720 |
| 2— | 50 | G.E. Vertical | KT546 | 720 |
| 2— | 50 | Reliance b.b. New | CC504U | 900 |
| 2— | 50 | Whse. | CS | 1200 |
| 2— | 50 | Howell TEFC | K445 | 1800 |
| 1— | 50 | Whse. hislip | WL607 | 900 |
| 1— | 50 | Fair. Morse b.b. | HJ-12D | 900 |
| 1— | 50 | Gen. Elec. | KT527 | 1800 |
| 1— | 40 | Louis Allis b.b. | OX404 | 3600 |
| 2— | 40 | Gen. Elec. | KT532 | 1200 |
| 2— | 40 | Gen. Elec. | KT538 | 900 |
| 2— | 40 | Gen. Elec. | KT346 | 600 |
| 7— | 40 | Whse. b.b. | CS-504 | 1200/900 |

### A. C. MOTORS — 25 CYCLE

| HP | Mfr | Type | Volts | Speed |
|---|---|---|---|---|
| 275 | G.E. synch. | ATI | 440 | 750 |
| 150 | Whse. | HF | 440 | 500 |
| 60 | Allis Ch. | ART | 440 | 1500 |
| 50 | Gen. Elec. Int. | MTC5337 | 440 | 750 |
| 50 | Gen. Elec. | I-K | 440 | 750 |
| 30 | Gen. Elec. | MT343 | 440 | 750 |

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QUICK SHIPMENT FROM STOCK—
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# SLIP RING MOTORS

**220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt**

| H.P. | MAKE | TYPE | SPEED | DESCRIPTION |
|---|---|---|---|---|
| 400 | G.E. | I-M | 1200 | S. B. |
| 300 | G.E. | I-M | 1200 | S. B. |
| 200 | G.E. | I-M | 1200 | S. B. |
| 150 | G.E. | I-M | 1200 | S. B. |
| 150 | G.E. | I-M | 1800 | S. B. |
| 100 | G.E. | MT-300 | 1800 | S. B. |
| 100 | G.E. | I-M | 900 | S. B. |
| 100 | G.E. | I-M | 720 | S. B. |
| 100 | G.E. | MT-343 | 1200 | S. B. |
| 75 | G.E. | I-M | 900 | S. B. |
| 75 | West. | CW | 720 | S. B. |
| 75 | G.E. | I-M | 720 | S. B. |
| 60 | G.E. | MT-333 | 1800 | S. B. |
| 40 | G.E. | I-M | 1800 | S. B. |

## BRAND NEW SQUIRREL CAGE MOTORS

**Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase**

| H.P. | MAKE | TYPE | SPEED | DESCRIPTION |
|---|---|---|---|---|
| 150 | G.E. | K-6328 | 3600 | TEFCBB |
| 150 | G.E. | K-6326 | 1800 | TEFCBB |
| 125 | G.E. | K-6328 | 1200 | TEFCBB |
| 100 | West. | CS-6078 | 1800 | TEFCBB |
| 100 | West. | CS-504 | 1800 | B. B. open |
| 75 | West. | CS-504 | 3600 | TEFCBBXP |
| 75 | A.C. | ARZ | 1800 | TEFCBB used |
| 75 | West. | CS-504 | 1800 | TEFCBBXP |
| 75 | West. | CS-445 | 1800 | B. B. open |
| 75 | F.M. | QB-445 | 1800 | B. B. open |
| 75 | West. | CS-505 | 1200 | TEFCBBXP |
| 60 | West. | CS-504S | 1800 | TEFCBBXP |
| 60 | G.E. | K-5948 | 1800 | TEFCBBXP |
| 60 | L.A. | 8G-44 | 1800 | B. B. open |
| 60 | F.M. | QB-444 | 1800 | B. B. open |
| 50 | Master | FB-404 | 3600 | TEFCBBXP |
| 50 | G.E. | K-445 | 1800 | TEFCBB |
| 50 | G.E. | K-405 | 1800 | S. B. drip |
| 50 | West. | CS-445 | 1200 | S. B. open |
| 50 | G.E. | K-505 | 900 | TEFCBBXP |
| 40 | A.C. | AR-444 | 3600 | TEFCBBXP |
| 40 | G.E. | KF-3658 | 3600 | B. B. splash |
| 40 | West. | CS-405 | 1800 | TEFCBB |
| 40 | L.A. | K-405 | 1800 | TEFCBBXP |
| 40 | G.E. | 404 | 1800 | B. B. open |
| 40 | Cr. Wh. | SC-445 | 1200 | TEFCBB |
| 30 | G.E. | KF-3658 | 3600 | B. B. splash |
| 30 | West. | CS-3658 | 3600 | S. B. splash |
| 25 | Linc.-Weld | DBD-328 | 3600 | B. B. open |
| 25 | West. | CS-364 | 1800 | S. B. splash |
| 25 | G.E. | K-364 | 1800 | S. B. drip |
| 20 | G.E. | K-364 | 1800 | S. B. drip |
| 20 | L.A. | EX-364 | 1800 | TEFCBBXP |
| 20 | G.E. | KF-404 | 1200 | TEFCBBXP |
| 20 | G.E. | KG-405 | 900 | TEFCBBXP |
| 20 | G.E. | KF-405 | 900 | TEFCBBXP |
| 15 | L.A. | EX-328 | 1800 | TEFCBBXP |
| 10 | West. | CS-2842 | 3600 | TEFCBB |
| 10 | Howell | EKBB-28-5 | 1800 | TEFCBBXP |
| 10 | Reliance | AA-CB-324 | 1800 | TEFCBB |
| 10 | West. | CS-324 | 1800 | TEFCBB |
| 10 | West. | CS-324 | 1800 | B. B. open |
| 10 | L.A. | EX-328 | 1200 | TEFCBBXP |
| 10 | G.E. | K-364 | 900 | S. B. drip |
| 10 | L.A. | R-1635 | 600 | TEFCBB |
| 3 | G.E. | K-224 | 3600 | TEFCBBXP |
| 3 | L.A. | EX-225 | 1800 | TEFCBBXP |
| 75 | G.E. | I-K | 900 | |
| 75 | G.E. | KT-343 | 1200 | S. B. |
| 75 | West. | CS-WL-607 | 1200 | S. S. B. |
| 75 | G.E. | KT-552 | 900 | S. B. |
| 75 | G.E. | KT-352 | 900 | S. B. |
| 75 | G.E. | KT-346 | 720 | S. B. |
| 60 | G.E. | KT-333 | 1800 | S. B. |
| 60 | G.E. | I-K | 1200 | S. B. |
| 60 | West. | CS | 1200 | S. B. |
| 60 | G.E. | KT-346 | 900 | S. B. |
| 60 | G.E. | I-K | 900 | S. B. |
| 50 | G.E. | I-K | 1800 | S. B. |
| 50 | Cr. Wh. | 25R | 1800 | S. B. |
| 50 | G.E. | KT-327 | 1800 | S. B. |
| 50 | G.E. | KT-336 | 1200 | S. B. |
| 50 | West. | CS | 1200 | S. B. |
| 50 | G.E. | KT-342 | 900 | S. B. |
| 50 | G.E. | KT-346 | 900 | S. B. |
| 40 | G.E. | K-444 | 1800 | B. B. |
| 40 | G.E. | KT-323 | 1800 | S. B. |
| 40 | West. | CS | 1200 | S. B. |
| 40 | G.E. | KT-336 | 900 | S. B. |
| 40 | F.M. | B-H12D | 900 | S. B. |
| 40 | G.E. | KT-342 | 720 | S. B. |
| 35 | Triumph | B-12 | 900 | S. B. |
| 35 | G.E. | I-L | 900 | S. B. |
| 35 | G.E. | I-K | 720 | S. B. |
| 30 | G.E. | KT-312 | 1800 | S. B. |
| 30 | West. | CS | 1200 | S. B. |
| 30 | G.E. | KT-332 | 900 | S. B. |
| 25 | G.E. | KT-312 | 1800 | S. B. |
| 25 | West. | CS-471 | 1800 | S. B. |
| 25 | Century | SC-36 | 1200 | S. B. |
| 25 | G.E. | I-K | 720 | S. B. |
| 25 | F.M. | B-H12-B | 720 | B. B. |
| 20 | West. | CS-364 | 1800 | S. S. B. splash |

## SQUIRREL CAGE MOTORS REBUILT

**220 or 440 Volt, 60 Cycle, 3 Phase, Open**

| H.P. | MAKE | TYPE | SPEED | DESCRIPTION |
|---|---|---|---|---|
| 200 | Wagner | RP-2-26 | 1800 | S. B. |
| 200 | Wagner | | 1200 | S. B. |
| 200 | G.E. | K-364 | 900 | B. B. new |
| 150 | West. | CS | 1800 | S. B. |
| 150 | G.E. | I-K | 1200 | S. B. |
| 150 | G.E. | I-K | 720 | S. B. |
| 100 | West. | CS | 1800 | S. B. |
| 100 | G.E. | I-K | 1800 | S. B. |
| 100 | G.E. | I-K | 1200 | |
| 100 | G.E. | KT-347 | 1200 | S. B. |
| 100 | West. | CS | 1200 | S. B. |
| 100 | West. | CS | 900 | S. B. |
| 100 | G.E. | I-K | 720 | S. B. |
| 75 | West. | CS | 1800 | S. B. |
| 75 | West. | CS | 1200 | S. B. |

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.
We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

# POWER EQUIPMENT COMPANY

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## *375 KVA - FOR SALE - 300 KW*

## WORTHINGTON-WESTINGHOUSE INSTALLATION

**COMMERCIALLY UNUSED**

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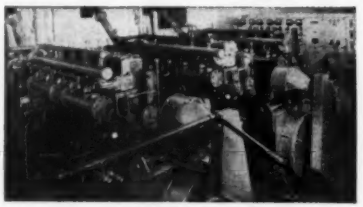

*Each Plant consists of*

3 Worthington Model 8B 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

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*Single units available*

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2—750 H.P. 200# WP Sterlings Located on Gulf of Mexico with new tubes.

2—250 H.P. 200# WP B & W Sectional Steel Headers. Located Toronto, Canada. Including Stoker and Stack.

1—1949 Combustion Engineering Spreader Stoker complete with Hagen controls and Board. Designed for 50,000 lbs. steam per hour, properly dismantled and boxed. AVAILABLE IMMEDIATE SHIPMENT.

# SPECIAL

***WE OWN and OFFER***

***Complete Power Plant consisting of***

**2 — 250 HP ERIE CITY**

1942, 200 lb. W.P., 3 drum, low head boilers, all control equipment, brass piping throughout, PEABODY oil burners and pump sets, feed water regulators, deaerating feed water heaters, headers, steam bends, catwalks.

***Offered, where is* — $17,500.00**

Each boiler equipped with a Pratt-Daniel Thermix Induced Draft stack, with turbine driven fan.

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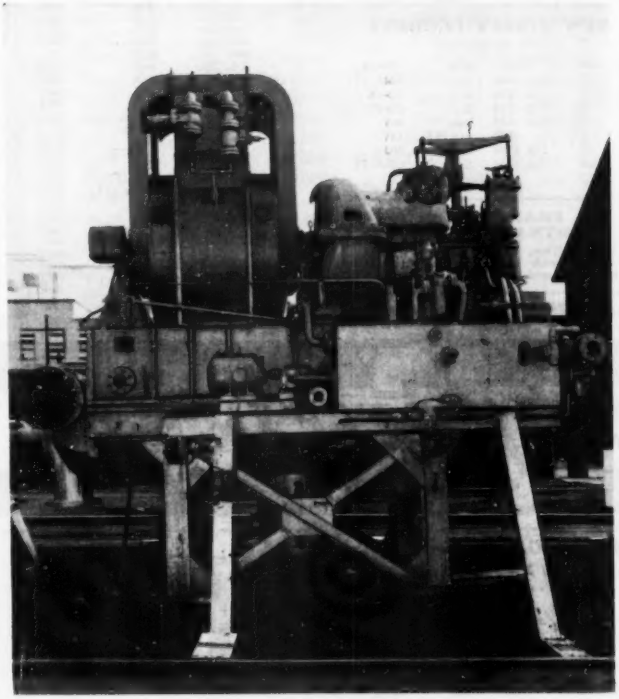
**WARNER J. SHERB, INC.**

**342 Madison Avenue, New York, N.Y.**

# POWER EQUIPMENT
## *FROM THE BOSTON METALS CO.*

## 2 Modern Package Turbo-Generator Sets



**PRESENTLY 2550 K.V.A.**
**2210 VOLTS. BUILT 1944**

**TURBINE:** Westinghouse — serial 2-A-9593-99 and 2-A-9593-100. Impulse reaction type—7 stage condensing—3500 H.P.—W.P. 440 p.s.i. —Temp. 740°—exhaust 27½" vacuum—weigh 13,000 lbs. Built 1944. Max. r.p.m. 4950—normal 4800.

**GENERATOR:** Westinghouse 109S20P900 & 108S20P900. 2 pole type—3 phase—82.5 cycles—2210 volts—2550 K.V.A.

**TURBO UNITS:** Mounted above Westinghouse condensers. 2 pass 27,500 lbs./hr. — cooling surface 2200 sq. ft.—vacuum 27½" Hg—cooling water capacity 3400 G.P.M. — condenser temp. 109° F — set mounted on pre-fab sub-base. Built 1944.

**Total Weight of Turbine, Generator & Condenser 56,250**

**UNITS CAN BE RE-CONNECTED FOR 60 CYCLE 3600 R.P.M.**

| | | |
|---|---|---|
| *1850 K.V.A.* | *100% P.F.* | *1610 volts* |
| *2100 K.V.A.* | *100% P.F.* | *1540 volts* |
| *1000 K.V.A.* | *80% P.F.* | *1610 volts* |
| *1200 K.V.A.* | *80% P.F.* | *1510 volts* |

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**313 E. Baltimore St.** **CURTIS 5050** **Baltimore 2, Md.**

# MOTORS - M.G. SETS - CONTROLS

## *NEW AND GUARANTEED REBUILT*

### M-G SETS

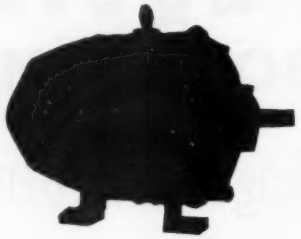
| KW | D.C. Volts | A.C. Volts | Mfg. |
|---|---|---|---|
| 500 | 125/250 | 2300 | Whse. |
| 400 | 125/250 | 2300 | Whse. |
| 300 | 250 | 2300 | Whse. |
| 200 | 250 | 2300 | Ridgeway |
| 150 | 250 | 440 | Whse. |
| 100 | 250 | 2300 | G.E. |
| 75 | 125/250 | 220/440 | Century |
| 50 | 250 | 440 | G.E. |
| 30 | 250 | 440 | Ideal |
| 30 | 125/250 | 2300/4000 | G.E. |
| 20 | 250 | 220/440 | G.E. |
| 7½VS | 250 | 220/440 | Rel. |
| 3VS | 250 | 220/440 | Rel. |

### SYNCHRONOUS

| HP | RPM | Volts | Mfg. | Type |
|---|---|---|---|---|
| 650 | 138 | 2300 | Whse. | Engine |
| 400 | 900 | 2300 | Whse. | 80% |
| 350 | 600 | 440 | Whse. | 100% |
| 250 | 200 | 440 | G.E. | 85% |
| 150 | 600 | 440 | G.E. | 100% |
| 100 | 900 | 440 | G.E. | 100% |
| 75 | 1200 | 440 | G.E. | 80% |
| 10 | 1800 | 220 | Whse. | 80% |

### SLIP RING

| HP | RPM | Volts | Mfg. |
|---|---|---|---|
| 700 | 514 | 2300 | G.E. |
| 500 | 1200 | 220/440 | Elliott (new) |
| 400 | 900 | 2300 | G.E. (new) |
| 350 | 450 | 2300 | Whse. |
| 300 | 600 | 220 | G.E. |
| 200 | 450 | 2300 | Burke |
| 100 | 1160 | 440 | G.E. |
| 50 | 720 | 220 | Whse. |
| 50 | 900 | 220 | G.E. |
| 40 | 900 | 230 | G.E. |
| 7½ | 1800 | 220 | Rel. (New) |



### NEW DIRECT CURRENT

*230 volt-dripproof*

| Qu. | HP | RPM | Mfg. | Frame |
|---|---|---|---|---|
| 1 | | 690/2660 | G.E. | 284 |
| 10 | 5 | 850/1700 | G.E. | CD-66 |
| 3 | 7½ | 575/1725 | G.E. | CD-77 |
| 1 | 7½ | 575/1725 | Rel. | 46T |
| 1 | 7½ | 1750 | Rel. (TE) | 14T |
| 1 | 10 | 575/2300 | L.A. | 4051 |
| 1 | 30 | 300/1800 | G.E. | CD-1377 |

**CRADLE TYPE DYNAMOMETER**

225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

### 230 V. DIRECT CURRENT

Reconditioned & Guaranteed

| HP | RPM | Mfg. | Brgs. |
|---|---|---|---|
| 100 | 450/1350 | Whse. | SI. |
| 50 | 500/1500 | G.E. | SI. |
| 40 | 400/1200 | Rel (TE) | Ball |
| 35 | 400/1200 | Ideal | SI. |
| 30 | 250/1000 | Whse. | S.SI. |
| 30 | 500/1500 | C-W (TE) | BB |
| 30 | 500/1500 | Rel | Ball |
| 25 | 250/1000 | G.E. | SI. |
| 25 | 400/1600 | Whse. | SI. |
| 25 | 600/1350 | Rel | Ball |
| 25 | 690 | Rel | Ball |
| 20 | 250/1000 | Whse. | SI. |
| 20 | 30/1200 | Rel. | Ball |
| 20 | 500/1500 | G.E. | SI. |
| 15 | 250/1000 | G.E. | SI. |
| 15 | 400/1600 | Whse. | SI. |
| 15 | 400/1200 | G.E. | SI. |
| 15 | 575/1000 | Rel | Ball |
| 15 | 575/1725 | L.A. | Ball |
| 15 | 650/1650 | G.E. | SI. |
| 15 | 700/1350 | Rel | Ball |
| 10 | 300/1200 | Whse. | SI. |
| 10 | 400/1600 | Whse. | SI. |
| 10 | 400/1600 | Rel | Ball |
| 10 | 600/1200 | Rel (TE) | Ball |
| 10 | 850 | Rel | Ball |
| 10 | 1750 | G.E. (TE) | BB |
| 7½ | 200/1200 | Whse. (TE) | Ball |
| 7½ | 300/900 | G.E. | SI. |
| 7½ | 400/1600 | Rel | SI. |
| 7½ | 400/1600 | Whse. | Ball |
| 7½ | 450/1200 | C-W | SI. |
| 7½ | 600/1800 | Rel (TE) | Ball |
| 7½ | 1150 | G.E. | SI. |
| 5 | 400/1200 | C-W | SI. |
| 3 | 850/1700 | Rel | Ball |

***Buy from BOSWICK with confidence***

WAlbridge 7195

# BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

## MOTORS—M.G. SETS—COMPRESSORS, ETC.

### M.G. SETS & CONVERTERS

| KW | MAKE | RPM | D.C. | A.C. |
|---|---|---|---|---|
| 750 | Al. Ch. | 720 | 250 | 440 |
| 500 | GE Rotary | 1200 | 250 | 2300 |
| 400 | West. | 720 | 550 | 2300 |
| 300 (2) | GE | 1200 | 250 | 2300 |
| 300 | GE Rotary | 600 | 250 | 2300 |
| 300 | West. | 1200 | 550 | 2300 |
| 200 | GE | 1200 | 250 | 2300 |
| 150 | GE | 900 | 250 | 2300 |
| 150 | West. Rotary | 1200 | 250 | 2300 |
| 50 | G.E. | 1200 | 250 | 2300 |

### A.C. MOTORS

| HP | MAKE | RPM | TYPE |
|---|---|---|---|
| 400 | GE | 450 | SI.Rg. |
| 300 | GE | 450 | SI.Rg. |
| 150 | GE | 600 | Sq.Cg. |
| 150 | GE | 600 | Syn. |
| 100 (2) | Allis | 720 | Sq.Cg. |
| 100 | West. | 900 | Syn. |
| 100 | West. | 1200 | Sq.Cg. |
| 100 | GE | 1750 | Sq.Cg. |
| 100 (2) | GE | 450 | SI.Rg. |
| 75 | West. | 900 | Sq.Cg. |
| 75 | GE | 600 | SI.Rg. |
| 60 | West. | 600 | SI.Rg. |
| 50 | GE | 1750 | Sq.Cg. |
| 40 | GE | 900 | SI.Rg. |
| 40 | West. | 900 | Sq.Cg. |

### AIR COMPRESSORS

336 CFM Chg. Ph. 12"x10" NSB 100#.
415 CFM Allis Rotary 100#.

**MOORHEAD ELECTRICAL MACHINERY COMPANY**

361 Noblestown Road (Est. 1919) Oakdale, Penna.

Pittsburgh District

## BOILERS—TURBINES

Complete Power Plant Equipment.

1—65,000 lbs. per hr. 450 lbs. pressure sectional steel header, 4" straight tube type boiler.

3—750; 3—600; 2—400 HP B&W vertical forged steel sectional header, 200 lbs. pressure water tube boilers. Also 1—75000# per. hour 250# pressure Water Tube Boiler.

1—Unused 140,000# per hour Combustion Engineering VU Type ASME Code 450# working pressure.

**A full stock of power and distribution transformers, switch gear, including potential and current transformers, circuit breakers etc. at reasonable prices.**

***We buy entire central station and power stations.***

***We do our own rigging and dismantling.***

**HOWE BROTHERS**

342 MADISON AVENUE Murray Hill 2-8562 NEW YORK 17, N. Y.

# TURBO-GENERATORS

250 KW, 300 KW A.C. and D.C.

2000 KW 3 phase, 50 cycles, 6300 volts

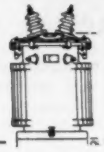
***Immediate delivery***

Packed in original crates

*Complete Specifications and Details Upon Request*

**INTERNATIONAL FERMONT MACHINERY CO., INC.**
**115 BROADWAY**
**NEW YORK 6, N. Y.**

# TRANSFORMERS



| QU. | KVA | MAKE | TYPE | PH. | PRIMARY | SECONDARY |
|---|---|---|---|---|---|---|
| 1 | 7500 | West. | Auto | 3 | 121,000Y | 69,500Y |
| 2 | 7500 | West. | OISC | 3 | 33,000Y | 13,800/6900 |
| 2 | 7500 | West. | Furn | 3 | 13,800 | 234-taps to 95 |
| 1 | 7000 | Mol. | FA-Auto | 3 | 110,000Y | 69,000Y |
| 1 | 5000 | Mol. | Auto | 3 | 110,000Y | 69,000Y |
| 1 | 5000 | West. | Furn | 3 | 2300 | 249 |
| 6 | 4500 | West. | OIWC | 1 | 110,000 | 44,000/22,000 |
| 1 | 4000 | G.E. | OISC | 3 | 4000 | 2400 |
| 1 | 3750 | West. | OA | 3 | 67,000 | 2400 |
| 1 | 3750 | UPTG | OISC | 3 | 22,000 | 550 |
| 3 | 3333 | West. | OISC | 1 | 138,000 | 13,200Y/7620 |
| 1 | 3000 | G.E. | OISC | 3 | 22,000 | 480 |
| 1 | 2800 | Gard. | Auto | 3 | 2400 | 1735 |
| 4 | 2500 | A.C. | OISC | 1 | 110,000 | 45,000 |
| 3 | 2500 | A.C. | OISC | 1 | 110,000 | 45,000/22,500 |
| 4 | 2500 | Mol. | CR | 1 | 69,000 | 13,800 |
| 3 | 2500 | West. | OISC | 1 | 27,600 | 2300 |
| 1 | 2500 | West. | Furn | 3 | 13,200 | 225-taps to 90 |
| 3 | 2000 | West. | OIWC | 1 | 110,000 | 44,000/22,000 |
| 1 | 2000 | West. | OIWC | 3 | 66,000 | 2300/440 |
| 1 | 1800 | West. | Furn | 3 | 13,800 | 239 |

| QU. | KVA | MAKE | TYPE | PH. | PRIMARY | SECONDARY |
|---|---|---|---|---|---|---|
| 1 | 1500 | West. | OISC | 3 | 121,000Y | 2300 |
| 1 | 1500 | West. | OISC | 3 | 69,500Y | 2300 |
| 1 | 1250 | Mol. | TCR | 3 | 110,000Y | 13,800Y/12,470Y |
| 1 | 1250 | Mol. | TCR | 3 | 69,000Y | 13,800Y/12,470Y |
| 3 | 1250 | G.E. | H | 1 | 13,800 | 600/575 |
| 1 | 1250 | West. | OISC | 3 | 13,860 | 525/460 |
| 3 | 1250 | G.E. | OISC | 1 | 2400 | 480 |
| 1 | 1200 | West. | OISC | 3 | 69,000 | 6900/2300 |
| 3 | 1000 | West. | OISC | 1 | 44,000 | 480 |
| 3 | 1000 | Pitt. | OISC | 1 | 22,000/11,000 | 220/1100 |
| 3 | 1000 | G.E. | OISC | 1 | 110,000 | 33,000 |
| 1 | 1000 | G.E. | OISC | 3 | 22,000 | 2300/460 |
| 3 | 1000 | A.C. | OISC | 1 | 33,000 | 6900/11,950Y |
| 3 | 1000 | A.C. | OISC | 1 | 6650/11,500Y | 2400 |
| 3 | 833 | G.E. | H | 1 | 23,000 | 2300/4000Y |
| 3 | 833 | G.E. | OISC | 1 | 13,800 | 230/460 |
| 4 | 750 | Wag. | BSR | 1 | 19,050/33,000Y | 6900/11,950Y |
| 3 | 750 | West. | OISC | 1 | 13,200 | 440 |
| 2 | 600 | G.E. | OISC | 3 | 115,000 | 13,800Y |
| 4 | 500 | A.C. | OISC | 1 | 66,000 | 33,000 |
| 2 | 200 | Mol. | CP-54 | 1 | 33,000/57,000Y | 13,200/6600 |

## OIL CIRCUIT BREAKERS — OUTDOOR

| QU. | AMPS. | VOLTS | KVA | TYPE | MAKE |
|---|---|---|---|---|---|
| 2 | 600 | 132,000 | 1,000,000 | G-22-S | West. |
| 1 | 600 | 115,000 | 1,000,000 | FHKO-139-54B-F2 | G.E. |
| 1 | 600 | 73,000 | 500,000 | FHKO-236-2452B-F | G.E. |
| 1 | 600 | 50,000 | 500,000 | FD-40B | Condit |
| 1 | 600 | 15,000 | 500,000 | O-221 | West. |
| 4 | 600 | 15,000 | 250,000 | FLO-1B | G.E. |
| 1 | 600 | 15,000 | 150,000 | FK-255 | G.E. |
| 1 | 600 | 15,000 | 100,000 | FLO-1B | G.E. |
| 1 | 600 | 15,000 | 100,000 | FK-44B | G.E. |
| 1 | 600 | 15,000 | 50,000 | O-1 | Condit |
| 1 | 600 | 7,500 | 100,000 | FK-255-M1-6 | G.E. |

| QU. | AMPS. | VOLTS | KVA | TYPE | MAKE |
|---|---|---|---|---|---|
| 1 | 400 | 115,000 | 1,000,000 | FHKO-39-60B | G.E. |
| 2 | 400 | 115,000 | 500,000 | FHKO-36-23B-F2 | G.E. |
| 1 | 400 | 110,000 | 1,000,000 | FHKO-39-60B-F2 | G.E. |
| 1 | 400 | 73,000 | 400,000 | FHKO-136-2046B-S | G.E. |
| 1 | 400 | 50,000 | 125,000 | JB-35 | Pac. |
| 2 | 400 | 50,000 | 100,000 | G-1 | West. |
| 1 | 400 | 37,000 | 50,000 | FKO-36-8CS | G.E. |
| 1 | 400 | 25,000 | 150,000 | FKO-136 | G.E. |
| 1 | 400 | 25,000 | 150,000 | FKO-136-1328A-S-25A | G.E. |
| 1 | 400 | 25,000 | 50,000 | O-1 | Condit |

## INDOOR

| | | | | | |
|---|---|---|---|---|---|
| 1 | 3000 | 15,000 | 1,000,000 | O-22A | West. |
| 1 | 800 | 15,000 | 60,000 | FK-132 | G.E. |
| 7 | 600 | 15,000 | 50,000 | FKR-32C | G.E. |
| 1 | 600 | 7,500 | 50,000 | FK-46 | G.E. |
| 1 | 400 | 25,000 | 25,000 | G-1 | West. |

| | | | | | |
|---|---|---|---|---|---|
| 1 | 400 | 15,000 | 20,000 | FK-132-A | G.E. |
| 6 | 400 | 7,500 | 25,000 | F-22 | West. |
| 1 | 300 | 15,000 | 40,000 | B-2 | West. |
| 1 | 300 | 15,000 | 20,000 | B-3 | West. |

**SUBSTATIONS—MERCURY ARC RECTIFIERS—MOTORS—STEAM TURBO GENERATORS**
**HYDRO ELECTRIC PLANTS—DIESEL POWER UNITS—DIESEL GENERATING PLANTS**
**MOTOR GENERATOR SETS — GENERATORS — STARTERS — FREQUENCY CHANGERS**
**FEEDER VOLTAGE REGULATORS**

ELECTRICAL CONSTRUCTION

*J. H. Anthony*

**527 SOUTH GREENWOOD AVENUE • PASADENA 10, CALIFORNIA**

**Cable Address: "JANTHON" • RYan 1-8076, SYcamore 2-6260**

# PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

## TOTALLY ENCLOSED, 3 PHASE A.C. MOTORS

| HP | RPM | VOLTAGE | DESCRIPTION |
|---|---|---|---|
| 1/10* | 900 | 220 | Peerless, round frame |
| 1/8 | 1800 | 220/440 | Delco, BB |
| 1/6* | 1200 | 220 | Peerless, round frame |
| 1/6 | 1800 | 440 | Howell, BB |
| 1/4 | 600 | 220 | Jeannin, BB |
| 1/4 | 1200 | 440 | Delco |
| 1/4* | 1200 | 220 | Peerless, round frame |
| 1/4 | 1800 | 440 | Delco |
| 1/4 | 3600 | 440 | Delco |
| 1/3 | 1200 | 220 | Allliers, round frame |
| 1/3 | 1800 | 440 | Delco |
| 1/3* | 1800 | 440 | Baldor, explosion proof |
| 1/3 | 3600 | 220/440 | Howell, round frame |
| 1/2* | 720 | 220 | Peerless, round frame |
| 1/2 | 900 | 220/440 | Delco |
| 1/2 | 1200/600 | 440 | Reliance, explosion proof |
| 1/2 | 1200 | 440 | Delco |
| 1/2* | 3600 | 550 | Diehl, 1/2 hr. 55 deg. C |
| 3/4 | 450 | 220 | G.E., round frame |
| 3/4 | 1800 | 220/440 | R&M, BB |
| 3/4 | 3600 | 440 | Delco |
| 1 | 3600 | 220 | Haskins, round frame, BB |
| 1-1/2 | 900 | 220/440 | Delco, BB |
| 1-1/2 | 1800 | 220/440 | Delco |
| 2 | 1200 | 220/440 | Delco, BB |
| 2 | 1800 | 220/440 | Reliance, explosion proof |
| 3 | 1200 | 220/440 | Baldor, BB |
| 3 | 1800 | 220/440 | Ideal, water cooled |
| 3* | 1800 | 220/440 | Delco, BB |
| 3 | 3600 | 440 | Westgh. |
| 5 | 1800 | 440 | Delco, BB |
| 5* | 1800 | 220/440 | Master, BB |
| 5 | 3600 | 550 | Continental, BB |
| 7-1/2 | 900 | 220/440 | Delco, BB |
| 7-1/2 | 1200 | 220/440 | G.E., high torque |
| 7-1/2 | 1200 | 220/440 | G.E., BB |

* New

## TOTALLY ENCLOSED, 3 PHASE, A.C. MOTORS—Cont'd

| HP | RPM | VOLTAGE | DESCRIPTION |
|---|---|---|---|
| 7½* | 1800 | 220/440 | Master, BB |
| 10 | 1800 | 220/440 | Howell, BB |
| 25 | 1200 | 220/440 | Reliance, BB |
| 30 | 900 | 440 | Reliance, BB |
| 50 | 1800 | 220/440 | Reliance |

## LOW VOLTAGE M.G. SETS

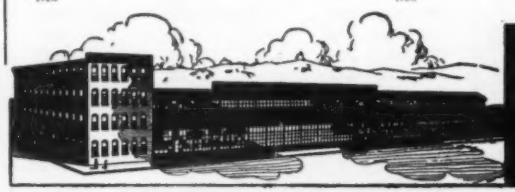
| D.C. OUTPUT AMPS. | D.C. OUTPUT VOLTS | A.C. DRIVE H.P. | A.C. DRIVE RPM |
|---|---|---|---|
| 7500 | 6 | 70 | 270 |
| 4000 | 2-8 | 50 | 425 |
| 2400 | 40/80 | 280 | 1200 |
| 1500 | 60 | 135 | 1200 |
| 1500 | 15 | 35 | 1200 |
| 1500/750 | 6/12 | 15 | 1200 |
| 1500/750 | 15 | 50 | 1200 |
| 1200 | 60 | 108 | 1200 |
| 1000 | 70 | 105 | 1200 |
| 1000 | 20 | 30 | 1200 |
| 1000 | 6 | 10 | 1200 |
| 750 | 24 | Rectifier | |
| 680 | 11 | 15 | 900 |
| 600 | 50 | 40 | 900 |
| 600 | 30 | 25 | 720 |
| 500 | 40 | 30 | 1200 |
| 500 | 12 | 10 | 1200 |
| 500 | 6 | Rectifier | |
| 416 | 12 | 7½ | 1200 |
| 400 | 40 | 25 | 1800 |
| 208 | 63 | 20 | 1800 |
| 200 | 15 | 5 | 1800 |
| 100 | 7½ | 1 | 1800 |
| 100 | 6 | 1 | 1800 |
| 50 | 10 | 1 | 1800 |
| 15 | 32 | 1 | 1800 |
| 10 | 19 | 1/4 | 1200 |

* New

## SLIP RING MOTORS 3 Phase, 60 Cycles

| HP | RPM | VOLTS | MFR. |
|---|---|---|---|
| 35 | 600 | 440 | G.E. |
| 35 | 720 | 220 | Wesche |
| 35 | 900 | 2200 | G.E. |
| 40 | 450 | 220 | Triumph |
| 40 | 600 | 2200 | Al. Ch. |
| 40 | 720 | 220 | Whse. |
| 40 | 900 | 220 | Al. Ch. |
| 45 | 1200 | 440 | Whse. |
| 50 | 720 | 440 | Al. Ch. |
| 50 | 900 | 2300 | Ridgeway |
| 50 | 1200 | 220 | F-M |
| 60 | 900 | 220 | G.E. |
| 60 | 1800 | 220/440 | Al. Ch. |
| 75 | 360 | 550 | G.E. |
| 75 | 600 | 440 | Al. Ch. |
| 75 | 720 | 440 | Al. Ch. |
| 100 | 400 | 440 | G.E. |
| 100 | 400 | 550 | W.E. |
| 100 | 720 | 440 | Al. Ch. |
| 100 | 600 | 220 | Triumph |
| 150 | 1800 | 440 | G.E. |
| 200 | 1800 | 440 | Al. Ch. |
| 250 | 300 | 2200 | Al. Ch. |
| 250 | 600 | 440 | Al. Ch. |
| 300 | 600 | 440 | Whse. |
| 300 | 720 | 2300 | Al. Ch. |
| 300 | 1200 | 440 | Whse. |
| 350 | 514 | 220/440 | G.E. |
| 375 | 1800 | 2300 | Al. Ch. |
| 450 | 900 | 2200/4160 | G.E. |
| 500 | 900 | 440 | G.E.—3 Brg. |
| 500* | 900 | 2200/4160 | G.E. |

* New



**GLOW ELECTRIC CO.**
927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

# TRANSFORMERS

**SINGLE PHASE—60 CYCLES (unless otherwise stated)**

| Qty. | KVA | Make | Type & Form | Prim. Volts | Sec. Volts |
|---|---|---|---|---|---|
| 3 | 1250 | GE | H—VDOJ | 13800 | 575/500 |
| 1 | 500 | GE (3 PH) | | 4160 | 120/208 |
| 1 | 300 | PITTS. | | 2875 | 230/199/115 |
| 1 | 250 | GE (3 PH) | HT—R | 460 | 216Y/125 |
| 3 | 200 | PITTS. | ODSC | 2300 | 575 |
| 4 | 200 | PITTS. | | 4150 | 460 |
| 2 | 200 | WEST. | S | 2400/4160 | 900 |
| 3 | 200 | MOLONEY | | 575 | 230/115 |
| 1 | 150 | PITTS | ODSC | 13200 | 2300 |
| 11 | 150 | WEST. (3 PH) | | 13530/13200/12870 | 208/120 |
| 15 | 150 | WEST. (3 PH) | | 13750/13400/13063 | 216/125 |
| 24 | 150 | GE (3 PH) | HT—R | 13750/13400/13063 | 216Y/125 |
| 51 | 100 | GE | H—KRW | 14375/14015/13655/13295/12935 | 216Y/125 |
| 37 | 100 | GE | H—VH | 13750/13400/13063/12720/12375 | 216Y/125 |
| 74 | 100 | WEST. | SK | 13750/13400/13063 | 250/125 |
| 38 | 50 | WEST. | SK | 13750/13400/13063 | 250/125 |
| 57 | 50 | WEST. | | 2750/2330/2321/1962/1927/1892/1375 (AIR COOLED) | 110/220 |

**MANY OTHERS IN STOCK—YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION**
**EMPIRE ELECTRIC COMPANY, INC., 87 Jay Street, Brooklyn 1, N. Y.—MAin 4-5900**

# FOR SALE

## USED HYDRAULIC PUMPS ONE ALDRICH VERTICAL

3 cylinder 8"x10" capacity 500 GPM 350 PPI driven by GE synchronous motor, 125 HP, 2300 volts, 60 cycle, 3 phase.

## TWO BLAKE HORIZONTAL

4½x15" capacity 228 GPM, 1000 PPI driven by GE synchronous motor, 175 HP, 2300 volts, 60 cycle, 3 phase.

**J. I. CASE COMPANY**
**BETTENDORF, IOWA**

## TRANSFORMERS—60 cycle

3—1250 KVA, A. Ch., 4800/460—3 ϕ
3—1250 KVA, A. Ch., 4160/460—3 ϕ
1—2500 KVA, A. Ch., 4800/460—3 ϕ
1—2500 KVA, A. Ch., 4160/460—3 ϕ
1— 667 KVA, A. Ch., 4160/460—3 ϕ
12—1250 KVA, G. E., 13200/440—1 ϕ
12—1250 KVA, G. E., 13800/440—1 ϕ
12—1250 KVA, G. E., 7200/12470Y/440 1 ϕ
2— 750 KVA, Gen. E., 11000/480; 3 ϕ, 25 cycle
3— 150 KVA, G.E., 12000/240/480, 1 ϕ
3— 100 KVA, Packard 2200/120/240 1 ϕ
1— 500 KVA, Scott Bank 2200, 3ϕ—pri. 220/440 2 ϕ
1— 100 KVA, Wagner, 480/120/240—1 ϕ
1— 325 KVA, Furn. 2300/4600/125—1 ϕ
1— 100 KVA, A. Ch., Furn. 440/110/80/60—1 ϕ
3— 75 KVA, A. Ch., 33000/2300/4160—1 ϕ WH. SW. GR.

## M.G. SETS

1000 KW, A. Ch. 250 V. DC, 1400 HP, 3 ϕ, 25 cycle. Or will consider changing motor for 60 cycle. Complete with switchgear.
200 KW, A. Ch., 125 v. D.C.; Mtr. 300 HP 3/30
40 KW—1000 amp., 40 V—DC mtr, 7 SHP 3/60
60 KW—1500 amp., 40 V—DC, mtr. 100 HP 3/60
100 KW, 125 volt D.C. mtr. 150 HP, 3/60
30 KW, 125 V D.C. mtr. 50 HP 3/60

## FREQUENCY CHANGERS:

KVA—465 25/60 cy. or 60/25—3 ϕ RPM 300 Motor 650 HP, 3 ϕ, 300 RPM with sw. gear
1—120 KW, 25/62½ cycle, 3 ϕ 720 RPM. Motor 200 HP 3/25/720 RPM
3— 20 KVA, G.E., 60/180 cycles 3 ϕ
3— 30 KVA, G.E., 60/180 cycle 3 ϕ
3— 25 KVA, G.E., 60/120 cycle 3 ϕ
1— 15 KVA, G.E., 60/120 cycle 3 ϕ

## SQUIRREL CAGE MOTORS 3 phase, 60 cycle

| HP | Make | Type | RPM | Volts |
|---|---|---|---|---|
| 150 | G.E. | IK14 | 1200 | 2300 |
| 100 | A. Ch. | S.C. | 690 | 440/550 |
| 100 | G.E. | IK17 | 400 | 220/440/2300 |
| 150 | G.E. | IK17 | 514 | 220/440/2300 |
| 75 | G.E. | IM S R | 600 | 220/440/2300 |
| 75 | G.E. | IK | 400 | 220/440/2300 |
| 75 | West. | CW S R | 1200 | 2300/440/220 |
| 50 | A. Ch. | ANY SR | 900 | 220/440 |
| 40 | Star | BB S R | 900 | 220/440 |
| 40 | G.E. | IK | 900 | 220/440 |
| 100 | G.E. | IK | 1800 | 220/440 |
| 200 | G.E. | KT 25 cyc. | 750 | 220/440 |
| 200 | West. | CS 25 cyc. | 750 | 220/440 |
| 150 | C. Wh. | 25 cycle | 480 | 2300/440/220 |

1—G.E. 3 pole switchgear 3700 volt 400 amp.
1—400 amp. 3 pole 15000 volt breaker G.E. FK132A

# VOLLAND ELECTRIC EQUIPMENT CO., INC.

**Subsidiary Co.—Buffalo Transformer Co.**

**1500 NIAGARA ST.** **BUFFALO 13, NEW YORK**

# POWER EQUIPMENT—READY TO SHIP

## A.C. MOTORS

### 220/440 volt 3 ph. 60 cy.

| HP | MAKE | RPM | TYPE |
|---|---|---|---|
| 300 | Elec. Mach. | 1800 | Syn. 2300 v. |
| 200 | Elec. Mach. | 1800 | Syn. |
| 250 | Gen. Elec. | 515 | tefc. KF-578 |
| 250 | Burke | 720 | syn. |
| 250 | Gen. Elec. | 1175 | I-2300 v. |
| 250 (4) | Westg. | 1775 | CS-8758 |
| 225 | Elec. Mach. | 1800 | Syn. |
| 200 | Gen. Elec. | 430 | tefc. KF-576 |
| 200 | Gen. Elec. | 880 | 2200 v. |
| 200 (3) | Wagner | 1750 | 220/440 |
| 200 | Gen. Elec. | 1800 | 2200 v. syn. |
| 175 | Westg. | 1200 | MS |
| 150 | Westg. | 257 | Syn. |
| 150 | Gen. Elec. | 400 | KF-576, 2200 v. |
| 150 | Gen. Elec. | 400 | tefc. |
| 150 | Westg. | 600 | syn. |
| 150 | Westg. | 1200 | hi-torq. |
| 150 (3) | Gen. Elec. | 1770 | vert. |
| 150 | Gen. Elec. | 1770 | tefc. 2200 v. |
| 150 | Elec. Mach. | 1758 | Syn. |
| 125 | Elec. Mach. | 164 | Syn. |
| 100 | Fairbanks-Morse | 360 | Syn. |
| 100 | Gen. Elec. | 875 | KT-558 |
| 100 (2) | Gen. Elec. | 1700 | tefc. |
| 75 | Elec. Mach. | 900 | Syn. |
| 75 | Louis Allis | 1800 | PX-565B |
| 60 | Triumph | 1200 | B-132 |
| 60 | Gen. Elec. | 1800 | KT-533 |
| 50 (3) | Westg. | 900 | 550/220/440 |
| 50 | Gen. Elec. | 1150 | KT-336 |
| 50 | New Reliance | 1760 | tefc. |
| 50 | New Gen. Elec. | 1800 | tefc. K-504 |
| 40 | Gen. Elec. | 570 | KT-540 |
| 40 | Cr. Wh. | 720 | |
| 40 | Westg. | 900 | Syn. |
| 40 | Gen. Elec. | 855 | KT-336 |
| 40 | Gen. Elec. | 1200 | KT-332 |
| 40 | Gen. Elec. | 1630 | KR-444 |
| 40 | Allis-Chal. | 1800 | |
| 40 | Gen. Elec. | 3600 | FT-513Y |
| 35 | Westg. | 686 | |
| 35 | Onan | 1800 | 8yn. |
| 30 | Gen. Elec. | 790 | hi-torq. |
| 30 | Gen. Elec. | 860 | KT-332 |
| 30 | Allis-Chal. | 1750 | |
| 30 | New Louis Allis | 1800/1200 | |
| 30 (2) | Gen. Elec. | 3600 | KT-205 |
| 25 | Commonwealth | 560 | 504 |
| 25 (2) | Westg. | 865 | CS |
| 25/7½ | Continental | 1150/575 | |
| 25 | Howell | 1200 | SC |
| 25 | Westg. | 1160 | CS |
| 15 | Gen. Elec. | 570 | KT-326 |
| 15 | Gen. Elec. | 900 | I-K |
| 15 | Westg. | 865 | CS |
| 15 | New Gen. Elec. | 1150 | hi-torq. |
| 15 | Louis Allis | 1150/1740 | OMX-404 |
| 15 | Louis Allis | 1750/566 | FX-345Y |
| 15 | Louis Allis | 1750 | OX-328 |
| 5 (8) | Gen. Elec. | 1150 | tefc. |
| 5 (50) | Westg. | 1150 | CS |

## SLIP RING MOTORS

### 3 ph.—60 cy.

| HP | MAKE | RPM | TYPE | VOLTS |
|---|---|---|---|---|
| 400 | West. | 438 | | 2200 |
| 200 | West. | 580 | CW-1000 | 220/440 |
| 150 | West. | 870 | CW-874C | 2200 |
| 150 | West. | 870 | CW | 220/440 |
| 100 | Triumph | 580 | | 550/440/220 |
| 75 | Gen. Elec. | 600 | IM | 550/440/220 |
| 60 | Gen. Elec. | 570 | MTC-5346 | 220/440 |
| 60 | Burke | 1200 | emv-7 | 220/440 |
| 50 | All.-Chal. | 690 | | 220/440 |
| 50 | Gen. Elec. | 900 | IM | 220/440 |
| 50 | West. | 880 | ci-638A | 220/440 |
| 50 | Gen. Elec. | 865 | MT-346 | 220/440 |
| 50 | Wagner | 1140 | | 220/440 |
| 50 | Gen. Elec. | 1200 | MT-342 | 220/440 |
| 40 | Gen. Elec. | 1170 | MT-336Y | 550/220/440 |
| 35 | Gen. Elec. | 865 | I-M | 2200 |
| 35 | West. | 690 | ci-646 | 220/440 |
| 35 | Gen. Elec. | 690 | I-M | 2200/440/220 |
| 30 | All.-Chal. | 575 | ABY | 220/440 |
| 30 | West. | 870 | | 220/440 |
| 25 | Gen. Elec. | 650 | MTC-5326 | 220/440 |
| 25 | West. | 570 | CI | 220/440 |
| 20 | West. | 1200 | | 220/440 |
| 15 | All. Chal. | 575 | | 2200 |
| 15 | West. | 855 | CW-546 | 220/440 |
| 15 | West. | 870 | CW | 220/440 |
| 15 | Howell | 1800 | SR | 220/440 |
| 10 | West. | 600 | CW-504 | 440 |

## GEARHEAD MOTOR

1—NEW 10 Hp., Westinghouse 220 v. 3 ph. 60 cy. 900 rpm., to 20 rpm type FD-326F, frame W326 type CS.

## VARIABLE SPEED MOTORS

### 230 Volt D.C.

| HP | Speed | Make | Type |
|---|---|---|---|
| 100 | 500/1000 | Westinghouse | SK-190 |
| 100 | 625/1250 | Westinghouse | S-13 L |
| 75 | 600/1200 | Westinghouse | — |
| 50 | 300/1200 | Crocker Wheeler | CMC |
| 40 | 285/1200 | General Electric | — |
| 40 | 250/1000 | Westinghouse | SK-141 |
| 35 | 350/1400 | General Electric | RF16A |
| 33 | 300/1200 | General Electric | CD-123 |
| 25 | 325/975 | Westinghouse | — |
| 25 | 500/1500 | Westinghouse | SK-110L |
| 20 | 400/1600 | Westinghouse | SK-123 |
| 20(3) | 500/1500 | Westinghouse | SK-110L |
| 15(2) | 400/1600 | Westinghouse | SK |
| 10(2) | 500/2000 | Westinghouse | SK-103 |
| 10(6) | 400/1600 | General Electric | — |
| 5(6) | 400/1600 | Westinghouse | SK-70 |

## MOTOR GENERATOR SETS—

### 250 V. D.C.

### Motors 220/440 volt or 2200 volt

| No. | KW | Make | Rpm |
|---|---|---|---|
| 2 | 200 | Westinghouse | 1200 |
| 1 | 100 | Westinghouse | 700 |
| 1 | 100 | General Electric | 900 |
| 1 | 100 | Westinghouse | 600 |
| 1 | 100 | General Electric | 1800 |
| 1 | 100 | Reliance | 580 |
| 1 | 100 | Delco | 1200 |

## SPECIAL BARGAINS

### Diesel Engine Generator Sets

2—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 250 HP Model GBD-R, 3½x7, 6 cyl. Superior DIESEL Engines, elec. start with engine panels.

2—100 KW same as above with 220 or 440 v. NEW A.C. Generators.

10—37½ kva. 3 ph 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A.C. Generators with dir. con. exciters driven by 70 HP., 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.

1—37½ kva., 3 ph. 60 cy. 127/220 v. or 220/440 v. Century 1800 rpm., dir. con. exciter driven by 72 HP., Model 6DTG317, Buda Diesel Engine with panel.

1—86 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 300 rpm DIESEL.

4—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 50 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.

5—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels.

## CLEANING MILL

1—Ransohoff Cleaning Mill 48" x 72", side loading side unloading, star return, with sand handling conveyor complete with tank, pump and motors.

## TRANSFORMERS

### 1 ph. 60 cy.

| No. | Kva | Make | Primary | Sec. |
|---|---|---|---|---|
| 3 | 500 | West. | 22000 | 2200 |
| 3 | 200 | Pgh. | 22000 | 2200 |
| 2 | 150 | Pgh. | 4600 | 115/230 |
| 1 | 110 | Pgh. | 4600 | 115/230 |
| 6 | 100 | Pgh. | 4600 | 115/230 |
| 2 | 100 | Allis-Chal. | 4800 | 120/240 |
| 2 | 100 | G.E. | 4800 | 120/240 |
| 1 | 75 | Pgh. | 4600 | 115/230 |

## BAKER LOCOMOTIVE CRANE TRUCK

Model CYA 3000 lbs. at 7' radius with 8 to 12' adjustable telescoping boom complete with slow control, hoist control and boom control.

## PUMPS

2777 GPM Fair. Morse Cent. 235' hd. 8" dis. 10" suc. 300 HP. A.C. Syn. Motor.

2083 GPM Fair. Morse Cent. 235' hd. 8" dis. 10" suc. 225 HP. A.C. Syn. Motor.

1382 GPM Fair. Morse Cent. 235' hd. dir. con. 150 HP. A.C. Syn. Motor.

***WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.***

## Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

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## UNUSED CENTRIFUGAL PUMPS

3 Goulds 2" Fig. 3769 centrifugal pumps, 200 GPM at 70 ft. head at 1750 RPM. Bases and couplings for direct motor drive included. (Pumps in storage Jersey City.)

**STOREY PUMP and EQUIPMENT COMPANY**
510 Harbour Commission Bldg., Toronto 1, Canada

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## SPECIAL TRANSFORMERS—YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGES

**ARROW TRANSFORMER CO., INC.**
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

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John H. Benson — Roy L. Wilimzig

## MOTORS!! PUMPS!!

4—250 HP, 1170 RPM, Allis Chalmers Squirrel Cage Splash Proof, Frame 630DSWW, 3/60/2300. Will reconnect 220 or 440

1—200 HP, 600 RPM, GE, Slipring IM, Frame 17, 3/60/220/440

1—150 HP, 514 RPM, Westinghouse Slipring, Type HF, 3/60/220/440

5—75 HP, 900 RPM, Westinghouse Squirrel Cage, Type CS, Frame 752C, 3/60/220/440

1—1000 KVA—AC Generator Westinghouse, 3/60/2300 V., 720 RPM

1—1000 KVA Synchronous Condenser, 3/60/2300/4000, 600 RPM

2—24x24 Dayton Dowd CS24, 16,500 GPM, 18.5/35 FT. HD., 360/450 RPM

*Phone, Write or Wire!*

**BENSON-WILIMZIG, INC.**
formerly C & S Machinery Co.
1708 N. 8th St. St. Louis, Mo.
GA-4290

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## FOR SALE—1000 KW 1250 KVA
## ALLIS-CHALMERS GENERATOR

600 Volt, 3-phase, 60 cycle, 300 RPM

**ANDREN MYERSON CORP.**
411 ATLANTIC AVE. Liberty 2-4300 BOSTON, MASS.

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*IN STOCK FOR IMMEDIATE SHIPMENT*

## NEW and REBUILT MOTORS

**GENERATORS • M. G. SETS • TRANSFORMERS**

*Write, Wire, or Phone Your Requirements • Cash for Your Surplus*

**PREFERRED** *Electric Motors Inc.*

230 HUDSON AVE., P.O. BOX 767, ROCHESTER 3, NEW YORK • HAmilton 3420

*This Seal* JLHP *...tells you what you buy is* **GOOD EQUIPMENT!**

**GUARANTEED GOOD BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF**

# HEMPHILL ELECTRICAL ENGINEERS

**TRANSFORMERS—60 Cycle**

| Qu. | KVA | MAKE | TYPE | Ph. | VOLTAGES |
|---|---|---|---|---|---|
| 1 | 2500 | Whse. | Hiperril | 3 | 66000/33000 pri. 240/480 sec. w/Taps |
| 3 | 1500 | Pitts. | | | 32000 pri., 2300 sec., w/Taps |
| 1 | 1500 | GE | Pyranol | 3 | 4150x2200V |
| 1 | 500 | Kuhl. | OISC | 1 | 4600x2300V |
| 3 | 400 | GE | H | 1 | 6900x2250V |
| 1 | 300 | Pitts. | ODSC | 1 | 7800x440V |
| 1 | 200 | GE | HT | 3 | 2300x220 |
| 1 | 200 | Whse. | Auto | 3/2 | 4150x2300 |
| 1 | 200 | Pitts. | OISC | 1 | 4600x110/220 |
| 1 | 200 | GE | Auto | 3/2 | 4150x2400 |
| 1 | 150 | GE | KS | 1 | 2300x220 |
| 1 | 100 | Pitts. | | 1 | 2750x110/220 |
| 3 | 100 | Wagner | RCKV | 1 | 240x120/120 |
| 2 | 100 | Whse. | SK | 1 | 4400x220/440 Taps |
| 2 | 50 | Whse. | Interteen | 1 | 2100x120/240 |

**SPECIAL—WELDING MOTOR GENERATOR SET**

1—176 KVA Whse. Welding Gen. Set, 1 Ph. 20V, 800 Amp 57% PF with Slip Ring Motor & Exciter

**MOTOR GENERATOR SETS**
**3 Phase, 60 Cycle**

| Qu. | KW | MAKE | SPEED | DC | AC |
|---|---|---|---|---|---|
| 1 | 1000 | GE | 514 | 600 | 2300/4150 Syn. |
| 1 | 300 | GE | 1200 | 250 | 2300 Syn. |
| 1 | 200 | Whse. | 900 | 250 | 220/440 Syn. |
| 1 | 150 | GE | 1200 | 125/250 | 2300 Syn. |
| 1 | 150 | Whse. | 600 | 125 | 4150 Syn. |
| 1 | 125 | CW | 1200 | 125 | 2300 SC |
| 1 | 100 | CW | 1200 | 125 | 220/440 SC |
| 1 | 100 | El. Mach. | 1200 | 125 | 4150 Syn. |
| 1 | 91 | GE | 1200 | 60 | 440 SC |
| 3 | 94 | GE | 1200 | 60 | 4150 Syn. |
| 1 | 75 | Cr. Wh. | 1200 | 250 | 4150/2200 syn. |
| 2 | 40 | El. Mach. | 1750 | 125 | 440 SC |

**SYNCHRONOUS**

300 HP El. Mach. 720 RPM 2300 V T E F. C. outdoor Service

200/100 HP Whse. 720/360 RPM 4150 V.

**SLIP RING**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2500 | GE | MT | 6600 | 257 |
| 1 | 250 | Whse. | CW | 440 | 600 |
| 1 | 200 | GE | MT | 2300 | 1800 |
| 1 | 200 | Whse. | CW | 440 | 600 |
| 1 | 200 | GE | MT | 440 | 600 |
| 1 | 100 | GE | IM | 440 | 400 |
| 1 | 75 | GE | MT | 220 | 200 Vert |
| 1 | 60 | GE | MT | 220 | 1750 |
| 1 | 60 | GE | MT | 440 | 900 |
| 1 | 50 | GE | MT | 220 | 1720 |
| 1 | 50 | GE | MT | 220 | 1200 |
| 1 | 50 | Whse. | CW | 220 | 900 |
| 1 | 50 | GE | MT | 220 | 1700 |
| 1 | 50 | GE | MT | 220 | 600 |
| 1 | 40 | GE | MT | 220 | 1200 |

**Member of The National Industrial Service Association, Inc.**

FOR POWER
J. L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK: LONGACRE 5-3227
PHONE NEW JERSEY: UNION 3-2600

**TURBO-GENERATORS**

2000 K.W., 3 ph., 60 cy., 150 lbs G.E.
1000 K.W., 3 ph., 60 cy., 250 lbs G.E.
750 K.W., 3 ph., 60 cy., 250 lbs extract. G.E.
500 K.W., 3 ph., 60 cy., 150 lbs G.E.
150 K.W., 250 v., new Westgh., D.C.

**DIESEL UNITS**

62½ KVA., 3-60—Caterpillar
37½ KVA., 3-60—Ready Power
100 K.W., 250 v., D.C. Superior Delco

**UNUSED PUMPS & MOTORS**

Union Steam Co., pumps all 250 ft. head with new Louis Allis motors, 1750 RPM

1—200 GPM, 30 HP motor
1—400 GPM, 50 HP motor
1—500 GPM, 75 HP motor
1—900 GPM, 100 HP motor

**TRANSFORMERS**

3—200 KVA Westgh., 11500 x 480 V.
7—100 KVA Gen. Elec., 11000 x 2200 V.
3—100 KVA Maloney 11400 x 2200 V.
2—100 KVA Gen. Elec., 2400 x 120—240 V.
4— 50 KVA Gen. Elec., 11000 x 2300 V.
2— 50 KVA Westgh., 13800 x 230—460 V.

**3 PH., SLIP RING MOTORS**

425 HP., Gen. Elec. MT414Y, 392 rpm.
200 HP., Gen. Elec. IM.—585 rpm.
200 HP., Westgh., CW., 1750 rpm.
200 HP., Gen. Elec., IM., 435 rpm.
150 HP., Gen. Elec. IM., 1000 rpm.
150 HP., Gen. Elec. IM., 514 rpm.
100 HP., Reliance AW6085—600 rpm.
100 HP., Gen. Elec. IM—570 rpm.
100 HP., Gen. Elec. IM—585 rpm. Also 75 HP down

**SQUIRREL CAGE & SYN.**

300 HP., Gen. Elec., syn, 257 rpm.
250 HP., Burke syn, 360 rpm.
200 HP., Gen. Elec. KT550, 1150 rpm.
100 HP., Westgh., Syn, 900 rpm.
100 HP., Gen. Elec. KT543, 1800 rpm.
100 HP., Elec. Mchy, syn, 300 rpm.
90 HP., Gen. Elec. syn, TS7552, 900 rpm. Many smaller sizes

We carry a large stock of all kinds of direct current motors etc. What have you for sale? What do you need?

**KEYSTONE POWER PLANT EQUIPMENT CO.**
8403 Hegerman St. Phila. 36, Penna.

# BOILERS

**READY TO SHIP!!**
*FACTORY NEW*
**Package Steam Generators**
(available due to changes in Buyers' delivery plans)

2— 10 HP Cyclotherm, 15 lbs. pr. ±2 oil
2— 20 HP Cyclotherm, 15 lbs. pr. ±2 oil
1—100 HP Cyclotherm, 150 lbs. pr. ±6 oil

**— GOOD USED BOILERS —**
**SPECIAL VALUE AND PRICE**

1—20,000# steam/hr. ERIE CITY 3-drum low head Water Tube; 160# pr. LIKE NEW: INSTALLED 1948 — USED LESS THAN 3 MOS. Incl. Peabody Oil Burners w/preheaters; Soot Blowers; Condensate Pump; Blowers; Piping; Gauges; Feed Pump; Sup. Steel and Stack. Offering less than ½ replacement cost. Located Brooklyn.

**J. PARKER THOMPSON CO., Inc.**
**507 5th Ave., N.Y.C. MU. 7-6547**

COMPRESSOR: Worthington 2 stage, 29/18-½x 21, 600 H.P. synchronous motor, 3 phase, 60 cycle, 440 volts, 180 RPM, 100 lbs. pressure, 3000 CFM, complete with auxiliary equipment. In operation now, available immediately.

COAL CRUSHER: Jeffrey Flextooth 24x42", with 75 H.P. Allis Chalmers type ARZ motor, 3 phase, 60 cycle, 2300 volt, 24 hrs., 55 deg., 1170 RPM, with 5 groove V belt pulley.

DIESEL MOTOR: 122 H.P. Caterpillar D13000 complete with clutch, V-belt pulley, and spare parts.

DRAG SCRAPERS, CRESCENT BUCKETS: 1—Sauerman 2 yd. Drag Scraper outfit complete, without 75 H.P. motor. 1—Sauerman ¾ yd. capacity complete with 30 H.P. motor. 1—Sauerman 1 yd. capacity complete with diesel motor.

**A. J. O'NEILL**
**Lansdowne, Pa.**
**Phila. Ph.: Madison 3-8300—3-8301**

**FOR SALE: 2—Steam Engine Generator Sets**

ENGINES: Skinner Uniflow. GENERATORS: Westinghouse 375 KVA, 220 Volt, 3-60.
*Complete with panels and all accessories. Boilers also available.*

**ANDREN MYERSON CORP.**
411 ATLANTIC AVE. Liberty 2-4300 BOSTON, MASS.

3—STEEL BLDGS—167x200—70x200—57x135—50x60'
1—Steel Stack—120'x1⅛"x54" dia. Like New
1—50 Ton Bridge Crane—220-3-60 cy. Motors
3—Overhead Cranes; 5 ton 69'-' Span AC Motors
6—365 HP Heine WT Boilers 150# P. Stokers
1—675 KVA GE Gen. dir. con. Non R. Corl. Eng.
1—50 HP 125# Firebox Boiler; Refined; Stack

**H. & P., 6719 Etzel, St. Louis 14, Mo.**

**PULVERIZER**
B. & W. E-26 Class 221B
6000 pounds per hour
55 Grindability
UNUSED

**MERRILL and COMPANY**
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Telephone: HArrison 7-8289

## TURBO GENERATORS

### 3 Phase 60 Cycle

15,625 KVA G.E. condensing, 250 lbs., 500° FTT, 13,200 volts.

12,500 KVA Allis condensing, 225 lbs., 550° FTT, 13,200 volts.

6,250 KVA Allis condensing, 200 lbs., 500° FTT, 2300/4000 volts.

5,000 G.E. non-condensing extraction, 600 lbs., 750° FTT, 125/150 lbs. extraction, 0-50 lbs. exhaust, 13,800/4000 volts.

4,000 KVA Allis condensing, 200 lbs., 500° FTT, 2300 volts.

3,750 KVA G.E. condensing, 150-250 lbs., 500° FTT, 2300/600 volts.

2,500 KVA G.E. condensing, 150 lbs. 500° FTT, 2300 volts.

2,500 KVA G.E. condensing extraction, 200 lbs., 550° FTT, 20 lbs. extraction, 480 volts.

1,875 KVA G.E. condensing, 150-250 lbs., 650° FTT, 2300 volts.

1,563 KVA G.E. condensing extraction, 250 lbs., 525° FTT, 15 lbs.

1,250 KVA G.E. condensing, 200-400 lbs., 650° FTT, 2300/4150 volts.

1,250 KVA Westg. condensing extraction, 150-200 lbs., 600° FTT, 5-25 lbs. extraction, 480 volts.

625 KVA Westg. non-condensing, 150-200 lbs., 600° FTT, 5-25 lbs. exhaust, 480 volts.

## UNIFLOW UNITS

### 3 Phase 60 Cycle

750 KVA Ames-Allis-Chalmers vertical, 150 lbs. steam, 5 lbs. exhaust, 2400/4160 volts.

625 KVA Skinner-G.E., 150 lbs. steam, 5 lbs. exhaust, 240 volts.

500 KVA Skinner-G.E., 125 lbs. steam, 5 lbs. exhaust, 480 volts.

312 KVA Skinner-G.E., 150 lbs. steam, 3 lbs. exhaust, 480 volts.

250 KVA (2) Skinner-E-M., 135 lbs. steam, 3 lbs. exhaust, 120/208 volts.

### SPECIAL

750 KVA Allis-Chalmers generator, 3 phase 60 cycle, 2300/4160 volts, 277 RPM direct connected to Ames 4 cylinder vertical uniflow steam engine, 125-150 lbs. steam pressure, 0-5 lbs. back pressure, 277 RPM. Complete with belt driven exciter, electric speed changer and all auxiliaries as in operation. New 1932—Excellent condition.

## BOILERS

540 HP Keeler, 250 lbs. steam, pulverized fuel or oil fired.

350 HP Keeler, 250 lbs. steam, stoker fired.

150 HP (2) Erie City, 6200 lbs. per hour, 150 lbs. steam, stoker fired.

## DIESEL GENERATORS

### 3 Phase 60 Cycle

1,388 KVA McIntosh-Seymour, 2300 volts, 300 RPM.

1,000 KVA DeLaVergne, 2400 volts, 200 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

880 KVA Worthington, 480 volts, 327 RPM.

695 KVA Fairbanks-Morse, 2400 volts, 300 RPM.

546 KVA Worthington, 480 volts, 327 RPM.

312 KVA Superior, 480 volts, 360 RPM.

## RECTIFIERS

4,500 KW Allis Chalmers Mercury Arc Rectifiers (2), 600 volts DC; 3 phase 60 cycle, 13,800 volts AC.

1,000 KW G.E. Mercury Arc Rectifier, 600 volts DC; 60 cycle, 13,200 volts AC.

## HIGH FREQUENCY GENERATORS

### 3 Phase 240 Cycle

2,860 KVA (3) New G.E. AC generators, Type ATB, 3 phase, 120/240 cycles, 4150 volts, 4800 RPM.

# INTERNATIONAL POWER MACHINERY CO.

**1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO**

# MOTORS • GENERATORS • TRANSFORMERS

## 7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

## ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

## 600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

## 400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

## 400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

## MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

### 350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 230 Volt DC, 720 RPM Single Bearing Machines.

## T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 3/60/220/440/1800 X-Proof.

## DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

## 125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators

### REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy., 2400/4160 pri., 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

# ERIE ELECTRIC CO., INC.

**124 CHURCH ST. BUFFALO, N. Y**

**CL. 4758**

## SLIP RING MOTORS 3-Ph., 60 Cy.

| HP | Volts | Make | Speed |
|---|---|---|---|
| 500 | 2200 | G.E. | 450 |
| 450 | 440/220 | Whse. | 514 |
| 350 | 2300/440 | G.E. | 450 |
| 300 | 440 | Whse. | 3600 |
| 250 | 440/220 | Whse. | 600 |
| 250 | 2300/550 | G.E. | 450 |
| 250 | 550/440 | G.E. | 1200 |
| 250 | 550/440 | G.E. | 1200 |
| 250 | 440 | G.E. | 600 |
| 200 | 440 | G.E. | 600 |
| 200 | 440 | G.E. | 450 |
| 188 | 4000/2300 | G.E. | 1800 |
| 150 | 440/220 | Whse. | 600 |
| 148 | 440/220 | Whse. (3) | 1800 |
| 145 | 4000/2300 | G.E. | 1800 |
| 125 | 550/440 | G.E. | 1200 |
| 100 | 440/220 | G.E. | 600 |
| 100 | 440/220 | G.E. | 900 |

## SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

| HP | Volts | Make | Type | RPM |
|---|---|---|---|---|
| 400 | 440/220 | G.E. | ATI | 600 |
| 300 | 2300/440 | G.E. | TS | 720 |
| 300 | 440/220 | G.E. | ATI | 600 |
| 250 | 440/220 | Whse. | HR | 277 |
| 250 | 440/220 | G.E. | ATI | 600 |
| 250 | 4000/2300 | El. Mchr. | Syn. | 600 |
| 240 | 2300/440 | G.E. | ATI | 720 |
| 200 | 4150/2300 | Whse. | G | 1800 |
| 120 | 440/220 | G.E. | ATI | 900 |
| 110 | 440/220 | G.E. | TS | 257 |
| 100 | 440/220 | Whse. | G | 1800 |
| 75 | 2300/440 | Whse. | GE | 600 |

## PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator, dir. conn. to 20 hp, G.E. sq. cage motor.

## CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37000 V., G.E., Type FHKO-238 outdoor type, high interrupting capacity.

## SQUIRREL CAGE MOTORS

| HP | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 650 | 440 | G.E. | PT | 3600 |
| 500 | 2300/4000 | Elliot | SC | 1800 |
| 350 | 2200 | G.E. | KT | 1200 |
| 300 | 2200 | G.E. | PT | 3600 |
| 250 | 440 | G.E. | IK | 720 |
| 250 | 2200 | Al. Chal. | 1800 | AR |
| 200 | 440 | G.E. | 720 | IK |
| 200 | 440 | G.E. | IK | 514 |
| 200 | 440/220 | Whse. | CS | 1200 |
| 200 | 440/220 | G.E. | KT | 1800 |
| 150 | 440 | multi sp. | 1800/600 | KT |
| 150 | 440/220 | Whse. | CS | 900 |
| 150 | 440/220 | G.E. | IK | 450 |
| 100 | 2300/550 | Whse. | CS | 900 |
| 150 | 440/220 | G.E. | KT | 720 |
| 150 | 440/220 | Howell | B. Brg. | 1800 |
| 150 vert. | 440/220 | G.E. | KTP | 1200 |
| 150 | 440/220 | G.E. | IK | 514 |
| 150 | 2300/440 | G.E. | KT | 600 |
| 100 | 2300/440 | G.E. | K | 1200 |
| 75 (5) | 550 | G.E. | KF | 1800 |

## A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 V., G.E.
3— 75 kva, 1800 rpm, 480/240 v., Whse.

## D. C. MOTORS

| HP | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 200 | 230 (2 new) | Cr. Wh. | CMC | 1800 |
| 225 | 230 | G.E. | CD | 680 |
| 150 | 230 | G.E. | CD | 1750 |
| 150 | 230 (2) | Whse. | SK | 850 |
| 100 | 230 | Cr. Wh. | CMC | 625 |
| 100 | 230 | G.E. | CD | 1750 |
| 75 | 230 | G.E. | CD | 1150 |
| 75 | 230 | Whse. | SK | 850 |

## MOTOR GENERATOR SETS

1—230 kw, 1200 rpm, 240 V., Whse., conn. to 250 hp, 2300 V., sq. cage.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 135 hp, 440/220 V., sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 130 hp, 2300/440 v., syn. motor.
1—85 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

## TRANSFORMERS 60 CY.

3—500 kva, G.E., 22000—2300 V.
3—333 kva, G.E., 13,200—2300 V.
1—300 kva, Al. Chal., 4600/4160—240/120 V., 3 phase
3—300 kva, Whse., 13200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, G.E., 13200—460/230 V.
3—200 kva, Whse., 2400—240/120 V.
3— 75 kva, Moloney, 4150—240 V.
1—150 kva, Whse., 2400—240/480 V. (Pyranol)
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4156—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
1—150 kva, Whse, GE, 13200-125/215 v., 3 ph.
3— 75 kva, Whse., 2400—240/480 V.
6— 50 kva, G.E., 2400—120/240 V.

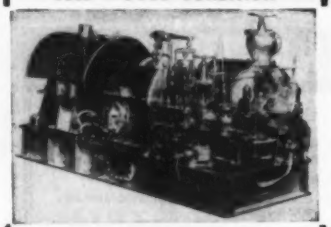
## STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

## FOR SALE
## TURBO GENERATORS

USED — GOOD CONDITION



**GE 200 KW 120V**
*ALSO AVAILABLE:*
**132 KW, 200 KW,**
**500 KW, 3/60/450 AC**

•

**1500 HP DC MOTORS**
**WESTINGHOUSE**

•

**1200 KW DC GENERATORS**
**—ALLIS CHALMERS**

•

**DIESEL DIVISION**
**NATIONAL METAL & STEEL CORP.**
Dept. P, Terminal Island
(Los Angeles Harbor), Calif.
Phone Los Angeles: Nevada 6-2517

## 100 KW GENERATOR SET

BUCKEYE DIESEL 400 RPM 3/60/240 with V-Belted exciter, Switchgear, Voltage Regulator, Oil filter, Silencer, Water Pump. Engine overhauled.

*Immediate delivery—Priced to Sell*

ROBERT L. KEISWANDER
418 S. Pearl—Lima, Ohio Tel. 42867

## WATER TUBE
## BOILERS

Union Iron Works Horizontal Straight Tube

2—259 H.P., single drum

2—350 H.P., two drum

*First-class condition*
*Immediate delivery*

**JAMES T. CASTLE CO., INC.**
**534 FIRST AVE.**
**PITTSBURGH 19, PA.**

## MOTOR GENERATOR SET

Complete with Control Panel, Meters and Oil Circuit Breakers with

**GENERAL ELECTRIC DIRECT CURRENT GENERATOR**

20 KW. 70 Amps. 115 Volts. Class 6-20-750 Form B. Speed 750 R.P.M. Shunt Type Cl. 25 No S.2298.

**SYNCHRONOUS MOTOR**

No. 413936 P.F.I. Type AT 1 Class 4-560-750. Form C H.P. 710 Speed 750. Volts 2300. Amps 140. Cycles 25. Pat'd. Aug. 13-95. Aug. 29-99. Nov. 20-00. Dec. 2-02. General Electric Co., Schenectady, N. Y., U.S.A.

**GENERAL ELECTRIC SYNCHRONOUS MOTOR**

No. S.2312 Class 10-500-750 Type A.T.B. Volts 550. Phase 3. Amps. 525. R.P.M. 750. Cycles 62.5.

**MONARCH KNITTING CO., LTD.**
Joseph Simpson Division
8 Berkeley St. Toronto 2, Canada

## FOR SALE
## DIESEL ELECTRIC GENERATING SET

Powered by Buda Diesel 8 cyl. engine, Model 8DC1125. 240 H.P. Maximum. Generator—Mfgd. by Electric Machinery Co., 3 phase, 220-440V, 75KW, 94 KVA. Generator V Belt Driven.

Equipment was new in 1948. Used very little. A-1 Condition. Priced for quick sale. *Phone or write*

**E. R. KLINGER LUMBER CO.**
**ELIZABETHVILLE, PA.**

## FOR SALE

2—Late 2000KW GE Turbo Generators
2—4000 HP Sync. Motors—257 RPM
1—Rotary Compressor 60000 CF/H 4#
1—IR Compressor 20,000 CF/H @ 100#

**Utility Equipment & Construction Co.**
**216 So. LaSalle Street, Chicago, Ill.**

## FOR SALE

*Diesel Engine & Generator Sets*

1—375 HP Worthington, 200 KW, GE Gen.
1—180 HP Worthington, 120 KW, GE Gen.
1— 45 HP GM Engine Gen. Set.
Switch Gear, Panel & Auxiliary Equip.

**THE F. E. SCHUMACHER CO.**
**HARTVILLE, OHIO**

## FOR SALE

**Two 7" Steel Boiler Angle Valves**

Non-return type for 250 lb. working pressure. Valves have been in service short time.

**STANDARD BREWING CO., INC.**
**440 Lake Avenue, Rochester 6, New York**

## PIPE FOR SALE

Approximately 7000 ft. 2" steel pipe. Approximately 5000 ft. 1¼" Black Wrought Iron Extra Heavy Pipe.

*This is used pipe in excellent condition*

**THE KLAGES COAL & ICE COMPANY**
**551 S. High St., Akron 11, Ohio**

# MOTORS—M. G. SETS—TRANSFORMERS

## SQUIRREL CAGE MOTORS
### 3-Ph., 60-Cy.

| Qu | HP | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 1 | 400 | G.E. | IK | 2200 | 514 |
| 1 | 400 | G.E. | KT-412 | 2200 | 435 |
| 2 | 300 | Whse. | CS-890 | 2300 | 1780 |
| 1 | 200 | Whse. | CS-873C | 2200 | 1160 |
| 1 | 200 | Al.Ch. | AR | 440/220 | 580 |
| 2 | 125 | Al.Ch. | AR | 2200 | 1750 |
| 1 | 125 | Whse. | CS-761C | 440/220 | 1750 |
| 1 | 125 | C.W. | 126-Q | 440/220 | 430 |
| 2 | 100 | Whse. | CS-863C | 440/220 | 1750 |
| 1 | 100 | G.E. | IK | 440/220 | 1800 |
| 1 | 100 | Al.Ch. | AR | 2200 | 1160 |
| 1 | 100 | Al.Ch. | AR | 550 | 690 |
| 1 | 100 | F.M. | H241B | 440/220 | 435 |
| 1 | 100 | Whse. | CS-938 | 2200 | 495 |
| 1 | 78 | G.E. | I-K15 | 440/220 | 570 |
| 1 | 75 | Al.Ch. | AR | 2200 | 1765 |
| 1 | 75 | Al.Ch. | AR | 2200 | 1750 |
| 1 | 75 | Al.Ch. | AR | 2200 | 690 |
| 1 | 50 | G.E. | KT | 440/220 | 1160 |

## SYNCHRONOUS MOTORS
### 3-Ph., 60-Cy.

| Qu | HP | Make | PF | Volts | RPM |
|---|---|---|---|---|---|
| 1 | 3000 | Whse. | 80 | 4800/2400 | 720 |
| 1 | 700 | G.E. | 80 | 2300 | 720 |
| 1 | 600 | Whse. | 80 | 2400 | 720 |
| 1 | 400 | Whse. | 80 | 440 | 600 |
| 1 | 300 | Whse. | 80 | 440 | 514 |
| 1 | 150 | G.E. | 100 | 2200 | 900 |
| 1 | 150 | G.E. | 100 | 550/2200 | 600 |
| 1 | 150 | G.E. | 80 | 550/2200 | 450 |
| 3 | 125 | El.Mchy. | 100 | 4800/2400 | 900 |
| 1 | 125 | G.E. | 80 | 2200 | 900 |
| 2 | 100 | Whse. | 80 | 440/220 | 1800 |
| 1 | 100 | Whse. | 100 | 2200 | 1200 |
| 1 | 100 | Ideal | 80 | 220/440 | 900 |
| 2 | 100 | G.E. | 80 | 220/440 | 600 |

## SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

| Qu | HP | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 1** | 3000 | G.E. | MT | 2200 | 356 |
| 1** | 1200 | C.W. | SR | 2200 | 237 |
| 2** | 1000 | Al.Ch. | ANY | 2200 | 235 |
| 1** | 600 | G.E. | MT-20 | 2200 | 360 |
| 1** | 400 | Al.Ch. | ANY | 2200 | 514 |
| 2 | 500 | G.E. | I-16-M | 2300 | 450 |
| 2 | 400 | G.E. | MT-412 | 2200 | 450 |
| 1 | 300 | G.E. | I-15-M | 2200 | 1200 |
| 1 | 300 | Al.Ch. | ANY | 2200 | 514 |
| 1 | 250 | Al.Ch. | ANY | 440 | 585 |
| 1 | 250 | G.E. | MT-414 | 2200 | 300 |
| 1 | 200 | G.E. | I-16-M | 2200 | 585 |
| 1 | 150 | G.E. | I-13-M | 2200 | 1750 |
| 1*** | 125 | Whse. | CW-870 | 2200 | 870 |
| 1 | 100 | F.M. | H20C | 440/220 | 900 |
| 1 | 75 | G.E. | 1M | 440/220 | 695 |
| 1 | 75 | Whse. | CW-7540 | 440/220 | 690 |

**Mill type pedestal bearing. ***3 bearing.

## MOTOR GENERATOR SETS

| Qu | KW | Make | RPM | Volts DC | Volts AC |
|---|---|---|---|---|---|
| 1 | 2400(3-U) | Al.Ch. | 720 | 525 | 4800/2400 |
| 1 | 2400(3-U) | Whse. | 720 | 600 | 4800/2400 |
| 1 | 1500 | Whse. | 514 | 250 | 4600/2300 |
| 1 | 1000 | G.E. | 514 | 550 | 2300 |
| 1 | 500 | C.W. | 720 | 250/275 | 2300/440 |
| 2 | 500 | C.W. | 720 | 575 | 2300/440 |
| 1 | 250 | Whse. | 1200 | 125/250 | 2300 |
| 1 | 200 | Ridg-way | 900 | 275 | 2200 |
| 1 | 155 | G.E. | 720 | 250 | 2300/440 |
| 1 | 150 | G.E. | 1200 | 500 | 2300/440 |
| 1 | 100 | C.W. | 1200 | 125 | 440/220 |
| 1 | 100 | Delco | 1200 | 125/250 | 440/220 |
| 1 | 100 | Ridg-way | 1200 | 275 | 4000/2300 |
| 1 | 85 | C.W. | 1200 | 250 | 2300/440 |
| 1 | 75 | Star | 1200 | 230 | 440/220 |
| 1 | 75 | Al.Ch. | 900 | 250 | 2300 |
| 1 | 75 | Whse. | 900 | 75 | 2200 |
| 1 | 25 | Ideal | 1750 | 125 | 220 |
| 1 | 20 | Al.Ch. | 1200 | 250 | 440/220 |
| 2 | 15 | Al.Ch. | 1200 | 250 | 440/220 |
| 1 | 15 | G.E. | 1200 | 250 | 440/220 |
| 1 | 10 | Whse. | 1200 | 250 | 440/220 |

3-U — 3-unit set.

We can furnish any of the above sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt for your requirements.

## TRANSFORMER — Power

| Qu | KVA | Make | Type | Phase | Voltage |
|---|---|---|---|---|---|
| 1 | 2760 | G.E. | DH | 3 | 6900-240/480 |
| 3 | 500 | Whse. | S | 1 | 13800-2400 |
| 4 | 333 | G.E. | H | 1 | 13200/11000-2200 |
| 3 | 250 | Packard | A | 1 | 13200-2200 |
| 3 | 130 | G.E. | H | 1 | 19000/9500-550/2200 |
| 3 | 100 | G.E. | H | 1 | 33000-2300 |
| 3 | 100 | Whse. | SS | 1 | 12075/10955-230/460 |
| 3 | 50 | Al.Ch. | O.I.S.C. | 1 | 22000-220 |

## DIRECT CURRENT MOTORS

| Qu | HP | Make | Type | RPM |
|---|---|---|---|---|
| 1*** | 3000 | Whse. | Encl.(Rev.) | 600 |
| 1*** | 2400 | Whse. | Encl.(Rev.) | 600 |
| 4*** | 1500 | Whse. | Encl.(Rev.) | 600 |
| 4*** | 1200 | Whse. | Encl.(Rev.) | 600 |
| 4*** | 800 | Whse. | Encl.(Rev.) | 600 |
| 1 | 350 | G.E. | CD-169 | 1150 |
| 1 | 325 | Whse. | QM-660 6 | 450/900 |
| 1 | 200/250 | El.Dy. | #22 | 400/120 |
| 1*** | 200 | G.E. | MPC | 500/1200 |
| 1 | 200 | Whse. | Mill | 300/1200 |
| 1 | 300 | Whse. | | 240/300 |
| 1 | 180 | G.E. | MPC | 400 |
| 2* | 150 | C.W. | 83-H | 890 |
| 1*** | 125 | Whse. | SK-190 | 600 |
| 2 | 125 | Whse. | SK-184 | 575/850 |
| 1 | 100/125 | Rel. | 1995-F | 300/1200 |
| 2 | 100 | Rel. | 1050-T | 400/1200 |
| 1 | 90/160 | G.E. | MPC | 625/1125 |
| 1* | 50/75 | Rel. | 1995-F | 300/1200 |
| 1 | 35 | G.E. | RF-14 | 500/1500 |
| 1 | 35 | G.E. | CD-125 | 400/1200 |
| 1 | 35 | G.E. | CD-147 | 300/1200 |
| 1 | 35 | Rel. | 35P | 250/1000 |
| 1 | 32½ | Whse. | SK-150 | 400/1200 |
| 1* | 30/75 | Whse. | SK-151L | 400/1200 |
| 1 | 30 | Al.Ch. | E-145 | 400/1200 |
| 1 | 30 | G.E. | CDM-105 | 875/1750 |
| 2 | 27½ | El.Dy. | 1SS | 450/1350 |
| 1 | 25 | G.E. | RF-13 | 400/1600 |

All above 230-VDC except where marked ***.
*** Pedestal bearing mill design 525/600-VDC (Rev.) Designed for mill reversing service.
* T.E.F.C.

# T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

## MONORAIL HOIST COMPLETE

**4 ton bucket hoist—3 motor high speed, with 2-4 wheel swivel trucks and Williams standpace bucket with safety catches**
**Coke Bucket**
**Hoisting cables**

## SPARE PARTS FOR HOIST

**40 H.P. 440 volt 3 phase motor**
**30 HP. 440 volt 3 phase motor**
**Torque motor 440 volt**
**Miscellaneous small parts**

***Available Immediately***

**Contact Gas Superintendent**

**WISCONSIN MICHIGAN POWER COMPANY**
**APPLETON, WISCONSIN**

## C. E. MULTIPLE RETORT STOKER

***IMMEDIATE DELIVERY***

Type MRO, 8 Retorts Continuous Steam Dump.
Width 14'-0". Length 14'-8"
Grate Area 205.8 sq. ft.
Steam-Electric with Lewellen Drive.

*Like new. Used only 6 months. Low Price.*

**AUTOMATIC COMBUSTION EQUIPMENT CO., INC.**
**P. O. Box 1478 Rochester 3, N. Y.**

## STEAM POWER PLANT

**5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ebasco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.**
**1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers. Sturtevant Inducted Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.**
**2—8000 HP Webster Water Heaters.**
**1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.**
**6—Steel Coal Bunkers, 80 tons each.**
**1—20,000 sq. ft. Wheeler 2-pass Surface Condenser.**
**1—9,000 sq. ft. Westinghouse 2-pass Surface Condenser.**
**1—4"x8" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam Turbine.**
**1—Kennicott Pressure Type Industrial Water Filter.**
**1—50-Ton Electric Traveling Crane.**
**1—25-Ton Hand Operated Traveling Crane.**

*Send for complete Inventory*

**MORSE BROS. MACHINERY COMPANY**
**2900 BRIGHTON BLVD.**
**P.O. Box 1708, DENVER, COLORADO**

## FOR SALE
### NEW AXIAL FLOW FANS

**Capacities 3000 to 16000 CFM**
**3 Phase, 440 Volts, 60 Cycle with Starters**
**Rugged Construction**
**Acid Resisting Vanes**
**Explosion & Waterproof Motors**
**2 Speed**
**For Horizontal or Vertical Installation**

***ALSO***

**New 35000 CFM, 230 Volt DC Axial Flow Fans**

**Eastern Scrap & Salvage Corp.**
**65 Muirheid Ave. Trenton, N. J.**
**Telephone: 506349**

## BOILERS

10 to 5000 H.P.
Diesel Steam Turbine, Engine

## GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment
UNUSED — RECONDITIONED

DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3386

## BOILERS—TURBINES—ENGINES

**Boilers 50-2000 HP; Turbo Gen. 100-6000 KW St. Eng. Gen. 75-1000 HP — *Write for our Free New List of High Grade Used Equipment.***

**BENJAMIN W. BISSELL, Reg. Engineer**
**521 K of P Building, Indianapolis 4, Ind.**
**Phone: Lincoln 4007**

# TRANSFORMERS

| KVA | Make | Voltages Pri. Volts | Sec. Volts |
|---|---|---|---|
| 7500 | | 33000 | 6900/13800 |
| 1500 | GE | 2300 | 600 |
| 1250 | GE | 13800 | 575/600 |
| 1000 | GE | 66000 | 7200/7025 |
| 1000 | West. | 2200 | 220 |
| 1000 | | 33000 | 2300 |
| 1000 | | 13800 | 240/480 |
| 750 | | 13800 | 2300 |
| 750 | GE | 2300 | 2300 |
| 500 | | 4160 | 120/208 |
| 500 | | 4600 | 460 |
| 500 | West. | 12000 | 480/240 |
| 500 | | 4600 | 230/460 |
| 500 | GE | 4160 | 480 |
| 500 | GE | 2400 | 240/480 |
| 500 | GE | 34500 | 230/460 |
| 450 | GE | 23000 | 445 |
| 450 | Uptegraff | 11000 | 460 |
| 400 | GE | 2400 | 480 |
| 333 | GE | 4150 | 120/240 |
| 333 | Packard | 2400 | 480 |
| 300 | Pitts. | 2300 | 115/230 |
| 250 | Pitts. | 4600 | 460 |
| 250 | GE | 460 | 216Y/125 |
| 250 | Pitts. | 2400 | 600 |
| 250 | West. | 2400 | 460 |
| 250 | West. | 463 | |
| 250 | West. | 13800 | 230/115 |
| 200 | Moloney | 600 | 220/110 |
| 200 | West. | 13200 | 2300 |
| 200 | GE | 4156 | 240/120 |
| 200 | GE | 495 | 120/240 |
| 200 | GE | 2200 | 122/244 |
| 200 | Penn. | 2400 | 480 |
| 200 | Moloney | 2400 | 230/460 |
| 200 | West. | 2300 | 600 |
| 200 | Pitts. | 2300 | 600 |
| 200 | GE | 11500 | 460 |
| 200 | West. | 3964 | 115/230 |
| 200 | GE | 6900 | 2400 |
| 150 | Packard | 4600 | 230/115 |
| 150 | GE | 2400 | 240/480 |
| 150 | Pitts. | 13200 | 2300 |
| 150 | GE | 2400 | 600 |
| 150 | Standard | 2300 | 230/460 |
| 150 | GE | 13800 | 115/230 |
| 150 | West. | 2400 | 240/480 |
| 150 | GE | 2400 | 240/480 |
| 150 | GE | 2200 | 110/220 |
| 150 | Pitts. | 7200 | 115/230 |
| 150 | GE | 4150 | 120/240 |
| 125 | West. | 440 | 440 |
| 125 | West. | 440 | 440 |
| 125 | Al. Ch. | 440 | 220/110 |
| 100 | Pitts. | 4600 | 230/115 |
| 100 | Al. Ch. | 6600 | 2300 |
| 100 | Pitts. | 13200 | 6900/11950Y |
| 100 | Uptegraff | 4160 | 40 |
| 100 | Pitts. | 2100 | 110/220 |
| 100 | Wagner | 3980 | 115/230 |
| 100 | West. | 13200 | 220/440 |
| 100 | Moloney | 2200 | 110/220 |
| 100 | GE | 460 | 115/230 |
| 100 | GE | 18490 | 2400/4800 |
| 100 | GE | 11500 | 230/460 |
| 100 | | 4600 | 2301 |
| 100 | GE | 11000 | 2300 |
| 100 | GE | 6900 | 2400/4160Y |
| 100 | GE | 4160 | 240/120 |
| 100 | GE | 2400 | 120/240 |
| 100 | Pitts. | 2300 | 115/230 |
| 75 | Pitts. | 2400 | 120/240 |
| 75 | Packard | 460 | 150/230 |
| 75 | GE | 2400 | 600 |
| 75 | Moloney | 440 | 110/220 |
| 75 | GE | 440 | 110/220 |
| 75 | West. | 6900 | 115/230 |
| 75 | Kuhlman | 4600 | 115/230 |
| 75 | Moloney | 2400 | 120/240 |

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**— World's Largest Inventory —**

**We Stock 1200 Units 5 to 75 KVA**

**ELECTRIC EQUIPMENT COMPANY**

**ROCHESTER, N. Y.**

**PHONE: LD-65**

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**Make a friendly connection, Call Sandman for stock deliveries. Partial Inventory of Rebuilt Guaranteed 3-40-220 & 440 V motors.**

**SQUIRREL CAGE**

| HP | RPM | Make | Remarks |
|---|---|---|---|
| 100 | 720 | G.E. | I-K |
| 50 | 1800 | Reliance | NEW BB |
| 40 | 1800 | Al-Ch | 284 |
| 35 | 1200 | G.E. | I-K |
| 30 | 3600 | F-M | BB |
| 30 | 1200 | C-W | BAH-405 BB |
| 30 | 600 | G.E. | I-K |
| 25 | 1800 | G.E. | KT-312 |
| 25 | 1200 | Cent. | SC30 |
| 25 | 1200 | West. | CN |
| 20 | 3600 | G.E. | KT203 |
| 20 | 1800 | G.E. | FT501 |
| 20 | 1200 | G.E. | KT312 BB |
| 20 | 1200 | G.E. | I-K 3 Shaft |
| 20 | 900 | Wagner | 15VRP |
| 20(4) | 600 | G.E. | FT 536 TEBB |
| 15 | 900 | B & M | L-840 |
| 15 | 514 | G.E. | KT552 |
| 10 | 1200 | G.E. | I-K |

**WOUND ROTOR**

| HP | RPM | Make | Remarks |
|---|---|---|---|
| 100 | 900 | G.E. | MT556 |
| 50 | 900 | G.E. | I-M |
| 40 | 720 | G.E. | MR-504 Hoist |
| 25 | 900 | West. | CH572A Hoist |
| 15 | 1200 | Wagner | 15VRS |
| 7½ | 1200 | West. | CW452 |
| 7½(2) | 900 | G.E. | MT958 |
| 5 | 1200 | Watson | KHTV |
| 5(2) | 900 | G.E. & West. | MT & CW |
| 3 | 1200 | Cleve. | MBW2375 |
| 3 | 900 | G.E. | MT944 |
| 2(2) | 1200 | G.E. & West. | MT & CW |
| 1½(4) | 1200 | G.E. | MT & CW |

**Also some 550 V & 2200 V ratings.**
**Largest New Motor Inventory in New England.**

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**SANDMAN ELECTRIC CO., INC.**

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**600 KW DIRECT CURRENT GENERAL MOTORS DIESEL SET. WESTINGHOUSE Generator, 500 Volt, 720 RPM, Electric Start. Unused.**

**450 HP ENTERPRISE DIESEL ENGINE. Model DSG-6, 6 Cyl., 4 Cy., 450 RPM air start, solid injection. Unused.**

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**STerling 3-6515**

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**Large Quantity of Rebuilt Fairbanks-Morse Squirrel Cage Motors. Type QZAK. Fully Guaranteed One Year.**

**220/440 VOLTS 3 PHASE — 550 VOLTS 60 CYCLE**

| HP | RPM | PRICE |
|---|---|---|
| 2 | 1200 | $ 67.50 |
| 3 | 1200 | 76.50 |
| 5 | 1800 | 76.50 |
| 5 | 1200 | 99.50 |
| 7½ | 1800 | 99.50 |
| 7½ | 1200 | 129.50 |
| 10 | 1800 | 129.50 |

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**of Washington**
**9265 E. MARGINAL WAY**
**SEATTLE 8, WASHINGTON**

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## 260 H. P. DIESEL ENGINE

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**MARTIN J. HANSON TRUSTEE**
**1500 N. KOSTNER AVE. CHICAGO 51, ILL.**

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## DIESELS—FOR SALE

**2—1250 HP, 4 cycle, 164 RPM MacIntosh-Seymour diesel engines driving 850 KW, 2 phase, 2300 volt, 60 cycle generators (can be rewound 3 phase). Units now in Central Station operation, probably available May 1952.**

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**Rockville Centre, N. Y.**

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## CAN BE INSPECTED NOW WHILE RUNNING

### BOILERS

2—*Edgemoore Boilers*, 600 H.P. each, 175 press water tube, equipped with type G-98 2" soot blowers & Illinois Stoker 10' x 15' type "G" chain grates & spare parts including all auxiliaries.

2—*Edgemoore Boilers*, 600 H.P. each, 175# press water tube equipped with type G-98 2" soot blowers & *Foster superheater & Riley spreader type stokers* & spare parts including all auxiliaries.

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1—*Brown-Boveri 5180 KVA*, complete in A-1 condition.

1—*Allis-Chalmers 3125 KVA*, completely overhauled in 1950.

1—*Westinghouse 1785 KVA*, complete in A-1 condition.

1—*Westinghouse Auto Starter Transformer, 500 KVA*, on 300 KD motor generator set, complete with all accessories.

Above units comprises complete power plant including or equipped with sub-station and all auxiliaries such as transformers, coal feed equipment, water softeners, pressure water filters, spray pond, exciters, pumps, switchboards, panel boards, etc.

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### MOTOR GENERATOR SETS

6—*Westinghouse 150 KW*, 275 V. 1200 R.P.M. with 220 H.P. 2200 V. Synchronous motor, complete with switchboard, relay & 1 oil circuit breaker.

1—*G.E. 150 K.W.* 275 V. 1200 R.P.M. with 225 H.P. 2300 V. synchronous motor, complete with switchboard, Relay, & oil circuit breaker.

1—*Allis-Chalmers, 300 K.W.* 2300 V. 600 R.P.M. complete with 120 V. Exciter & Westinghouse oil circuit brkr.

1—*Westinghouse 300 K.W.* 275 V. 900 R.P.M. with 450 H.P. 2200 V. Synchronous motor.

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125 HP GE 3/60/440V/1800 KT547/#5235285
200 HP GE 3/60/220V/900/K564/B.B. 5519486 W/Clark magnetic comp. Bul. 5000.
350 HP C.W. 3/60/2300V/3550 RPM/#1196854

### SLIP RING MOTORS

30 HP GE MT342 3/60/220V/720/#4002427
40 HP GE MT348 3/60/220V/900/#4012815
50 HP West. CW 3/60/220V/1175/#2240546
100 HP GE I-16 3/60/220V/430/Type I-16/#1578989
500 HP GE 3/60/2300V/900 RPM/#5275932

### SYNCHRONOUS MOTORS w/CONTROLLERS

75 HP West. 3/60/220V/1200 RPM Sealed Sleeve Brg. w/Dir. Con. Exc.
125 HP El. Mach. 3/60/4800V/900 RPM Ball Brg. w/Dir. Con. Exc.
135 HP GE 3/60/4000V/1200 RPM/T5963Z
175 HP Burke 3/60/2200V/720 RPM w/Dir. Con. Exc.

### MULTI-ARC WELDING M-G SETS

24-GE 1500 Amp. Synchronous driven w/AC & DC Panels

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250 KVA Elliot Turbo Gen. 3/60/208V/1200 RPM/ Equal to Unused
200 KW Ridgeway AC-DC 240V M-G Set
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One Enterprise Model DSQ-6, 16 x 20 Diesel Engine. 797 HP, 327 RPM. Direct connected to Elliott AC Generator 800 Kw 50° C. rise continuous. 2400 volts, 3 phase, 60 cycle, with all necessary switch gear and Maxim steam generating silencer. Used 14,275 hours.

One Enterprise Model DSQ-8, 16 x 20 Diesel Engine. 1075 HP, 327 RPM. Direct connected to Elliott AC Generator 1000 KVA, 800 Kw, 2400 Volt, 3 phase, 60 cycle, with all necessary switch gear and Maxim steam generating silencer. Used 17,423 hours.

One Fairbanks-Morse Model 32-E-14 x 17 Diesel Engine. 300 HP, 300 RPM. Direct connected to Generator, type TGZ-6, 250 KVA, 3 phase, 60 cycle, with all necessary switch gear and silencer. Used 27,000 hours.

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**St. Joseph, Michigan**

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# 4 ways to know your combustion efficiency

**The ever-increasing pressure for fuel economy makes some type of "combustion guide" instrument an essential part of any modern fuel burning operation. Hays offers the most complete line of such instruments in the industry—adaptable to your cost and engineering requirements. Your particular needs with regard to price, accuracy, speed of response, etc., will determine your choice—however, whatever your needs, Hays has the instrument.**

**Select your combustion guides *from the most complete line in the industry***

## 1 HAYS MAGNOTHERM

Measures fundamental indicator of combustion efficiency —Oxygen. Electronic in operation, with all of the most advanced features incorporated into its design, it is applicable not only to power plant conditions but also to a host of process problems such as catalytic crackers, open hearths, process heaters, inert gases, etc.

**PRINCIPLE**

Based on paramagnetic (attracted by magnetism) properties of oxygen. All other gases usually encountered are slightly diamagnetic (repelled by magnetism).

**FEATURES**

Highly sensitive to change in $O_2$ content
Rapid response to change in $O_2$ content
Electrically operated
Electronic type recorder
Temperature controlled
Pressure compensated
No liquid or gaseous fuel required to be added
No chemicals
High accuracy maintained
Not affected by wide change of gas flow rate
Continuous sampling and recording
Glass and corrosive resistant sampling system
Remote mounted analyzer
Remote mounted recorder
12" 24-hour chart
$O_2$ recorder and indicator
4 records on same chart possible
Low maintenance

## 2 HAYS CONDU-THERM GAS METER

Meter incorporates all of the construction and manufacturing ideas which Hays has developed during many years of experience in gas analysis. A deluxe instrument, the Condu-Therm $CO_2$ Analyzer is especially applicable to the larger boiler plants and to industrial processes.

**PRINCIPLE**

The principle of operation used in the Hays Condu-Therm Meter is that of thermal conductivity of gases, i.e., that all gases conduct heat at different rates.

**FEATURES**

Electrically operated
Electronic type recorder
Temperature controlled
Humidity controlled
No chemicals required
No moving parts in analyzer
Continuous sampling
No drying agent required
Easily installed glass and corrosion resisting sampling system
Not affected by wide change in gas flow rate
Rapid response
High sensitivity
Continuous recording
Remote mounted analyzer
Remote mounted recorder
12" 24-hour chart
$CO_2$ Recorder and Indicator
As many as 4 records on same chart
Low maintenance

## 3 HAYS COMBUSTION

Hundreds of these meters have been in operation for many years in all types of plants burning all kinds of fuels and saving thousands of fuel dollars.

**PRINCIPLE**

Operates on Orsat principle of Volumetric measurement and chemical absorption. Extremely simple: sample of flue gas trapped and accurately measured; passed through chemical which removes $CO_2$ component of gas mixture. Sample is re-measured, volume compared to original sample. Difference before and after absorption gives exact percentage of $CO_2$ absorbed by chemical.

**FEATURES**

Low price
Water operation
Pressure and temp. compensated
Volumetric determination
Chemical absorption
2 minute operating cycle
Easily understood
Rugged construction
Low maintenance
Available in 6 remote mounted types and 3 integral types
Remote or integral mounting
10" 24-hour chart
Available for: (a) $CO_2$ only—recording with or without indicator (b) $CO_2$ and flue gas temperature recorder combined (c) $CO_2$, draft or flue gas temperature recorder combined

## 4 HAYS-PENN BOILER

Provides a QUANTITATIVE guide to efficiency — deals with quantities of air and steam; by contrast $CO_2$ and $O_2$ meters are QUALITATIVE guides since they determine directly quality of combustion gases. Both Boiler Efficiency Meter and Gas Analysis Meter are used to obtain advantages of both methods.

**PRINCIPLE**

Pounds of air required to burn each pound of coal vary widely with heating value of coal; constant weight of air is required to produce same Btu. Similar relationship exists when oil and natural gas are used as fuels. Record of steam flow is assumed to be Btu's produced; record of air flow is calibrated to flow of air required to generate that steam.

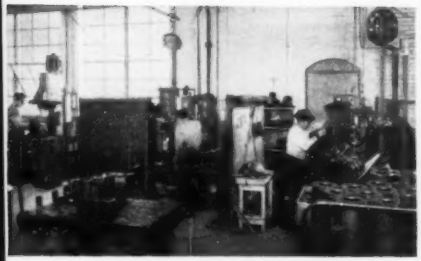
**FEATURES**

Electric operation of flow meter and air flow recorder
Diaphragm type air flow measuring unit
Air flow measuring element does no work
Air flow recorder—motor operated
Adjustable cam air flow calibration
Mercury transmitter—pressures to 2500 psi
Interchangeable range tubes for steam flow
Remote mounted steam flow transmitter
No high pressure piping into panel
Easily installed and adjusted
Low maintenance

**THE HAYS CORPORATION**
*MICHIGAN CITY 3, INDIANA*

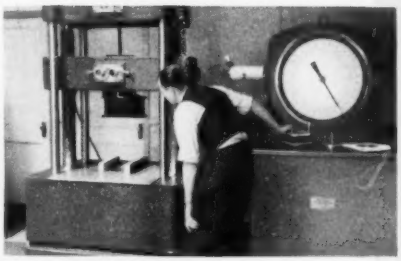
**Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages Combustion Test Sets • $CO_2$ Recorders • Electronic Oxygen Recorders**

# *Why Grinnell is America's #1 Supplier of* PIPE HANGERS *and* SUPPORTS



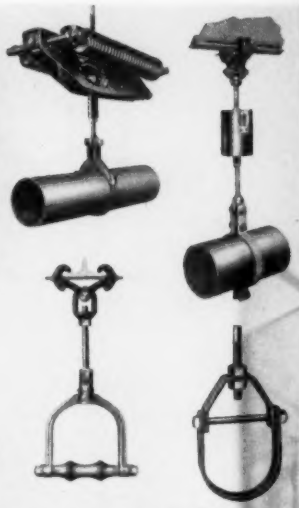
**GRINNELL, ALONE, MANUFACTURES A FULL LINE OF HANGERS AND SUPPORTS**

No other company, anywhere, makes a line as complete or varied. Grinnell produces hangers in thousands of combinations to support any piping.

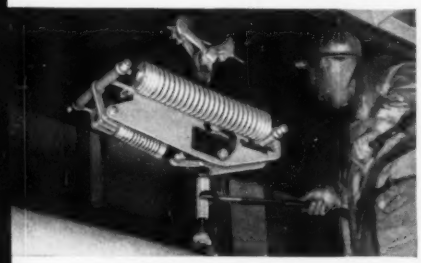


**GRINNELL, ALONE, MAINTAINS AN EXPERIENCED LABORATORY STAFF OF TRAINED TECHNICIANS**

In its modern, well-equipped laboratory, tests are constantly being made to discover better ways of solving old and new pipe suspension problems.



Grinnell makes scientifically designed, ruggedly built pipe hangers and supports for every type installation.



**GRINNELL, ALONE, PROVIDES ENGINEERING ASSISTANCE IN DESIGN AND INSTALLATION**

Grinnell makes available specialized knowledge in the computation of hanger loads and the selection of the correct supports. Engineers in the field assist with problems in erection of pipe hangers.

**GRINNELL, ALONE, THROUGH ITS CONVENIENT WAREHOUSES CAN SUPPLY YOU "OUT OF STOCK"**

No manufacturer of pipe hangers offers a distribution system as thorough or efficient. Grinnell warehouses are located in 30 principal cities . . . with jobbers in practically every city, coast to coast.

Pipe suspension presents an extremely wide range of problems involving weights, stress, thermal movement, materials and specialized engineering. No one "goes into" the pipe hanger business overnight. Large manufacturing facilities, skilled technicians, and a lot of down-to-earth practical experience are needed.

Grinnell has become America's No. 1 supplier of pipe hangers and supports only because Grinnell has specialized in piping for one hundred years. Grinnell has developed a line of pipe hangers and supports for every piping requirement, from the simplest to the most complex.

Grinnell is always ready to co-operate with engineers and architects in the preparation of pipe suspension specifications.

Call Grinnell for any and all types of pipe hangers and supports.

# GRINNELL

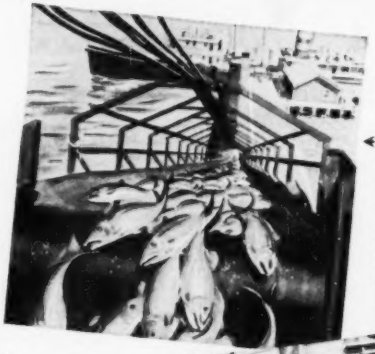
**WHENEVER PIPING IS INVOLVED**

Grinnell Company, Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports Thermolier unit heaters • valves • Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies • industrial supplies Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

# You can belt down handling costs

NO MATTER what the material you have to move—inside or outside your plant—it'll pay you to investigate conveyor belts. The G.T.M.—Goodyear Technical Man—can analyze your problems drawing on experience gained from successful installations throughout industry—match *your* problems with others to prove that conveyors can be the most economical cargo-handlers. And he can choose from a wide selection of belt constructions to specify the one that will give you the longest, most trouble-free service on your particular job. Get in touch with the G.T.M. today by calling your nearest Goodyear distributor, or writing Goodyear, Akron 16, Ohio.



**THREE TYPICAL G.T.M.-SPECIFIED CONVEYORS THAT ARE CUTTING COSTS**

◀ **Old-style chain conveyors** *outperformed by a Goodyear conveyor 3 to 1!* Over 1,000 tons of fish per hour are carried into the processing plant of this fertilizer maker, at lower cost per ton than ever before.

**Paper mills** everywhere are turning to conveyors to handle logs, chips and other raw materials. Here, too, the G.T.M. has made appreciable savings by designing systems to replace former materials-handling systems, ▼ operate at lower cost.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

GTM-Specified CONVEYOR BELTS

A few of the materials and service conditions that can be handled

Single flights up to 5 miles; lifts to 1500'
Extremely abrasive materials
Hot materials
Rugged service on grading machinery
Underground service in coal mines
Sanitary handling of foods in canneries
Extreme oil conditions
Soupy materials, like cement
Boxes and packages in plants and stores
Packaged or bagged materials on inclines
All types of grain handling

▲ **Assembly-line operations** can be conveyorized, too—with Goodyear's CHEMIGUM belts that withstand the attack of oil 50 times as well as natural rubber. That means longer life—lower cost—fewer interruptions of output.

Chemigum—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

**FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING, RUBBER-COVERED ROLLS** *built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.*

GOODYEAR

THE GREATEST NAME IN RUBBER